DESIGN edition

Post-formed Phenolics

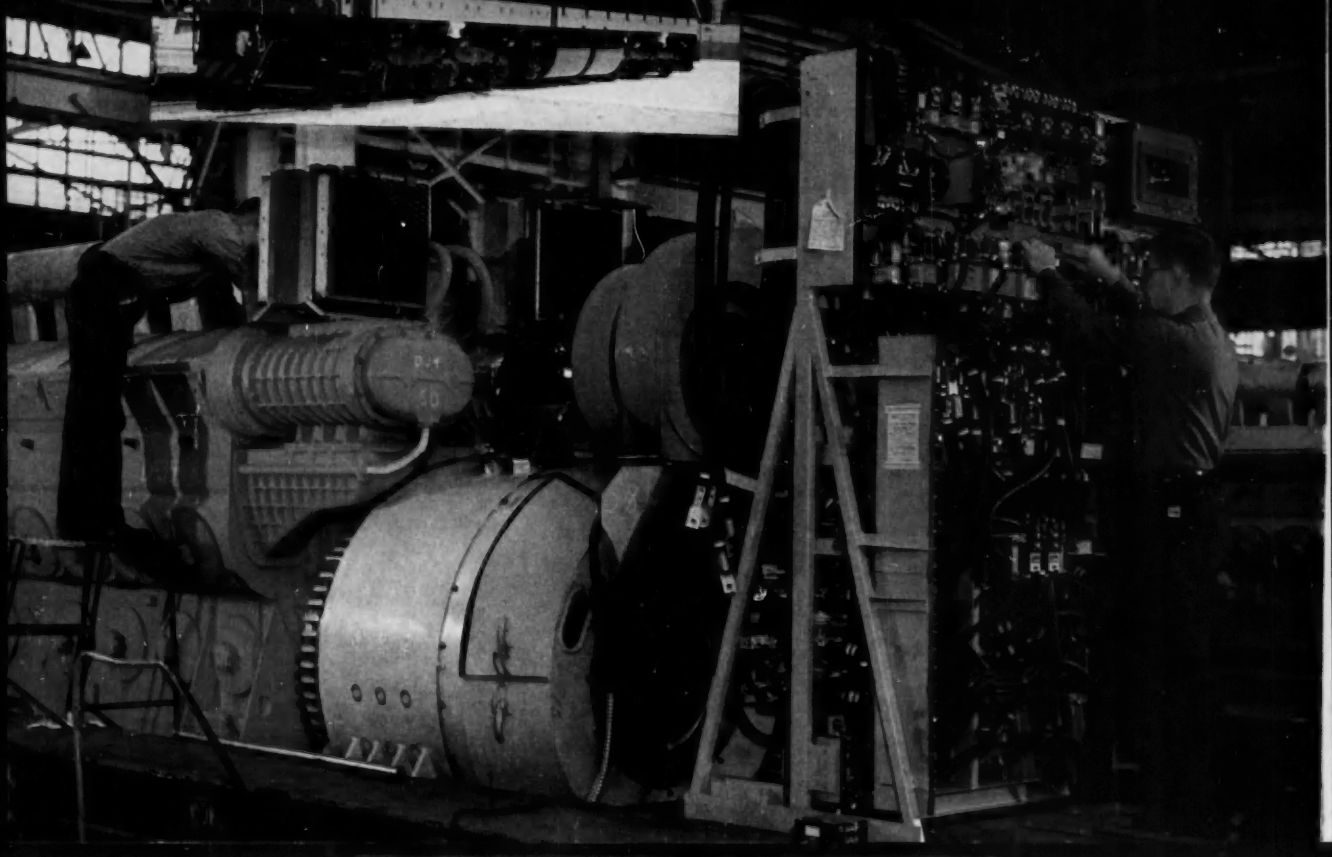
Variable-section Beams

FEBRUARY 17, 1958 PRICE 50 CENTS

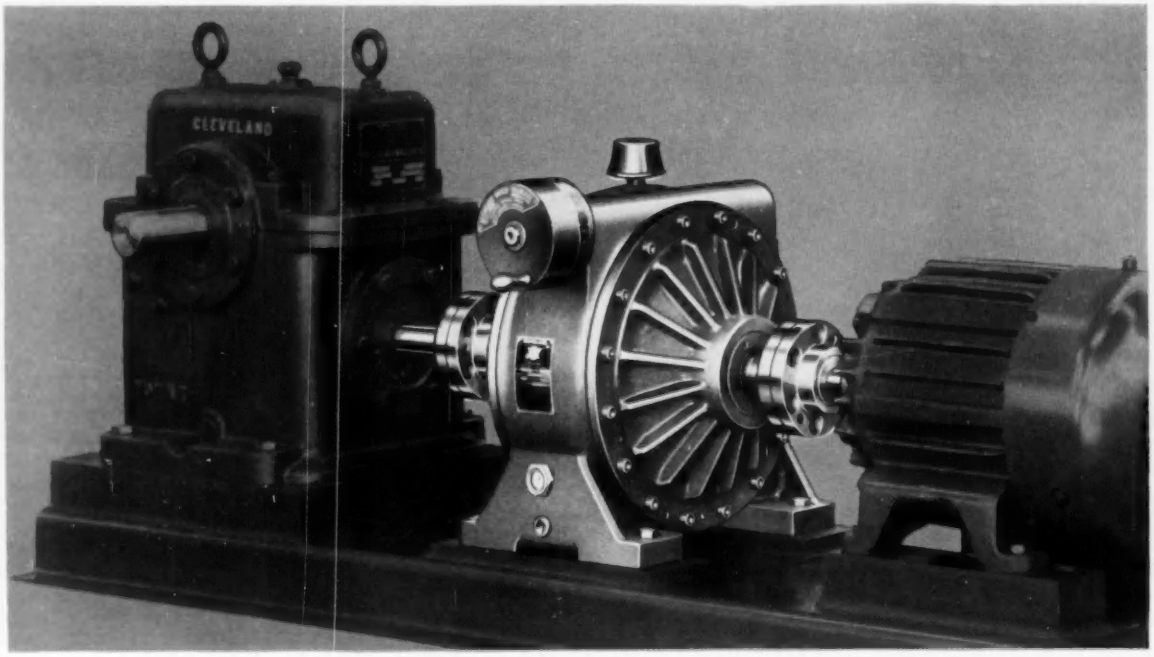
Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

Diesel Locomotives Designed for Upgrading — see page 5



Industry's most positive mechanical-type variable speed drive



CLEVELAND SPEED VARIATOR

Supplemented with speed reducers can provide reduction ratios to 10,000:1

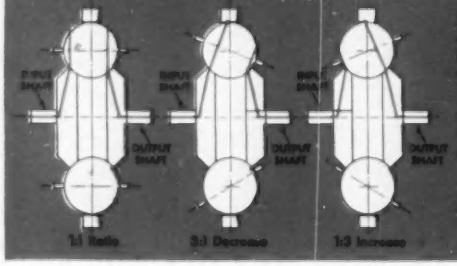
IN installing a Cleveland Speed Variator, the higher the input speed (normally 1750 rpm), the smaller the unit needed. Where power must be delivered at speeds below the Variator's normal output shaft speeds, further reductions are available between Variator and driven equipment.

As illustrated above, the Variator may be assembled with a standard worm gear speed reducer or with integral double reduction helical gear trains. Write for Bulletin K-200. The Cleveland Worm & Gear Company, Speed Variator Division, 3279 East 80th Street, Cleveland 4, Ohio.

Note these major advantages of the Cleveland Speed Variator

1. An extremely compact unit, with input and output shafts in line and rotating in the same direction.
2. Operable at any input speed up to 1800 rpm—either clockwise or counterclockwise rotation.
3. Rated for constant horsepower output over a 9:1 or 6:1 range; or for constant torque over a 6:1 range.
4. Infinitely variable output speeds over the entire range of adjustment.
5. No slippage—positive, automatic torque adjustment in direct proportion to the loads encountered.

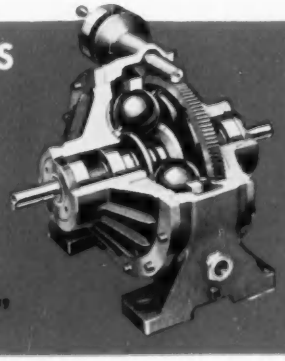
HOW THE CLEVELAND SPEED VARIATOR WORKS



Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts.

Relative speeds of the shafts are adjusted by changing the positioning of axles on which the balls rotate (diagram, right, shows cutaway Variator with hand regulating wheel).

"It's the Drive That's on the Ball."



"...AND WEIRKOTE CAN DO AWAY WITH PLATING OR DIPPING AFTER FABRICATION! IT WON'T PEEL OR FLAKE."

Q. A zinc-coated steel that won't peel or flake? That could save us a lot of money every month. Just what makes this Weirkote so special?

A. It's made by the continuous process, you know, which integrates zinc and steel so that the toughest fabrication won't break down the bond. You can work Weirkote to the very limits of the steel itself.

Q. Of course, that means the most complicated parts would have protection against rust. I like what I'm hearing. Is there more?

A. Yes . . . now Weirkote is treated to inhibit wet storage stain (white oxide). To make a long story short, I'd say this: With Weirkote, you can turn out a better product at lower cost. And you can free a lot of the capital, floor space and time you have tied up in plating operations.

Send for free booklet that details the time- and cost-saving advantages of skin-tight zinc-coated Weirkote. Weirton Steel Company, Dept. D-7, Weirton, West Virginia.

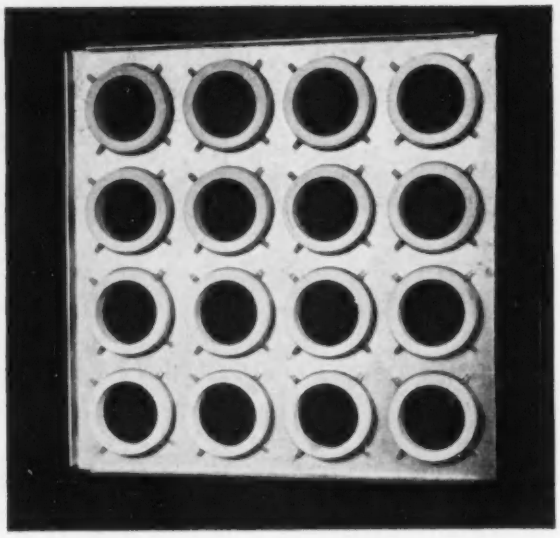
WEIRTON STEEL COMPANY

WEIRTON, WEST VIRGINIA

a division of

NATIONAL STEEL CORPORATION

How Armco ALUMINIZED STEEL Helps Electrical Resistors Fight Heat

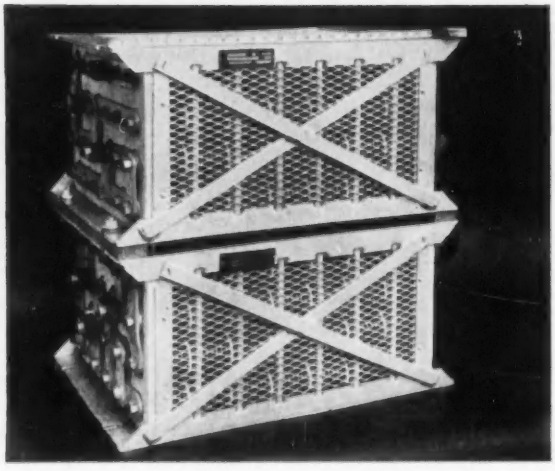


These high-temperature electrical resistors get **hot.** So every resistor part must resist heat. That's why Armco ALUMINIZED STEEL replaced aluminum-painted carbon steel for coil supports.

A leading manufacturer of electrical resistors for mine locomotives and mill cranes formerly made coil supports from carbon steel protected with aluminum paint. At high temperatures the paint flaked off, causing resistors to fail.

But such premature failures ended when the manufacturer switched to Armco ALUMINIZED STEEL for coil supports. The reason is the *hot-dip coating of aluminum* on ALUMINIZED STEEL. It alloys with the steel base... forms a refractory layer that doesn't flake off at temperatures up to 1250 F.

If heat, or a combination of heat and corrosion, cuts service life of your products, Armco ALUMINIZED STEEL Type 1 offers you this same positive protection. Just fill in and mail the coupon or contact your nearest Armco Sales Office for full information.



Other Armco Steels for top-quality products include ALUMINIZED STEEL Type 2, Stainless Steels, ZINCGRIP®, ZINCGRIP PAINTGRIP®, Cold-Rolled PAINTGRIP, Enameling Iron, Electrical Steels, Steel Tubing, Long Ternes, and high-quality Hot- and Cold-Rolled Sheets.

ARMCO STEEL CORPORATION
1508 Curtis Street, Middletown, Ohio

PLEASE SEND complete information about Armco ALUMINIZED STEEL Type 1. We make_____

NAME_____ TITLE_____

FIRM_____

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CITY_____ ZONE____ STATE_____

ARMCO STEEL

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Product Engineering

THE McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

FEBRUARY 17, 1958 Vol. 29, No. 7

Post-formed Phenolic Laminates 66... Harry Storch, Formica Corp.
Parts shaped from prelaminated sheet stock are as good as, often better than, those made by molding and laminating simultaneously. Here's how to design for this economical process.

High-integrity Aluminum Castings 69... A. R. Mead, Grumman Aircraft
These tips from practical experience will help choose the right alloy, strengthen critical areas, appraise foundry techniques.

Dry Batteries: Packaged Power 72... Dr. J. J. Coleman, Burgess Battery
Today's batteries give more juice—and improved design of parts lessens the load on them. Roundup shows what they now offer.

Porcelain Coatings on Steel 75... L. E. Russell and H. P. Tripp, General Electric
Lower firing temperatures and new enamels cut cost, and now permit a single coating for ordinary cold-rolled steel. Article also gives basic facts on coating with porcelain enamel.

Design Features in New Products 78... Diesels designed for rebirth; interlock monitors paper register; bellows controls camera exposure; car door slides back; flywheel houses press motor; new features in foreign machine tools.

Variable-section Cantilever Beams 83... Dr. Karl Maier, Olin-Mathieson
When spring action is more important than rigidity, use nonrectangular beams. Author supplies a first look at working equations derived to help choose among 4 variable-section types.

Sandwich Manifolding 88... A. A. Dicke, Monarch Machine Tool Co.
If a hydraulic circuit design threatens to become a discouraging complex of tubing and fittings, why not connect components through a "built-in" manifold?

DESIGN FILE

Metal Diaphragms and Capsules 92... D. C. Whitten, Bristol Co.
Eleven ways to use them for gas- and fluid-pressure problems.

Moment-of-Inertia Chart 95... W. G. Flannelly, Kaman Aircraft Corp.
Figuring moment of inertia of an irregular-shaped section is usually a tough problem. Master-chart method eases the job.

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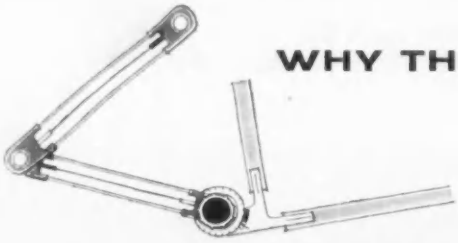
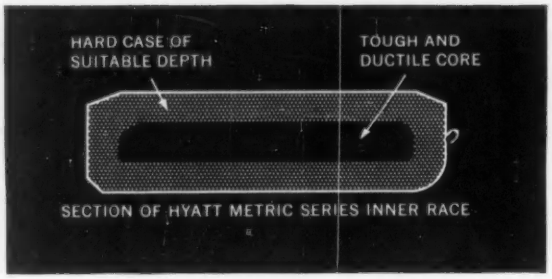
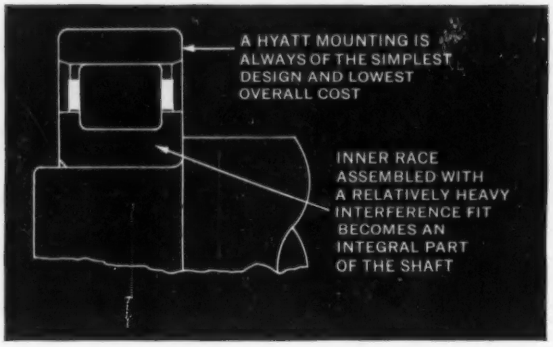


WHY THINGS RUN SMOOTHER WHEN YOU SPECIFY HYATTS

1. CARBURIZING PERMITS HEAVIER INTERFERENCE FITS



2. HEAVIER FITS SIMPLIFY MOUNTING, REDUCE COSTS


A HYATT MOUNTING IS ALWAYS OF THE SIMPLEST DESIGN AND LOWEST OVERALL COST
INNER RACE ASSEMBLED WITH A RELATIVELY HEAVY INTERFERENCE FIT BECOMES AN INTEGRAL PART OF THE SHAFT

HYATT PIONEERED THE USE OF CARBURIZING TYPE ALLOYS IN ORDER TO OBTAIN THE ADVANTAGES OF HEAVIER RACE FITS

To obtain the best possible performance, roller bearing races must be assembled on shafts and in housings with fits developed by design and experience. The most frequent condition to be met is a rotating shaft where specific load and speed conditions must be satisfied with appropriate race fits. These vary according to the manufacturer, and in the case of some manufacturers, according to the application. Naturally, the fits will also vary according to bearing type and size. How HYATT achieves the optimum in heavier race fits is detailed at right.

You will find full selection and application data in HYATT Catalog 150, or call your nearest HYATT Sales Engineer. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.; Pittsburgh; Detroit; Chicago; and Oakland, Cal.

1 With the standard metric series of cylindrical roller bearings there is a choice of two fitting practices: (1) Inner races of through-hardening steel, which dictates fairly light interference fits to avoid splitting. (2) Inner races of low carbon steel carburized and hardened to develop a suitable surface hardness and a tough ductile core. The latter permits much heavier interference fits and eliminates holding devices, because the race becomes practically an integral part of the shaft.

2 HYATT originated the carburized race and relatively heavy inner race fits to simplify bearing mounting and eliminate retaining devices. Practically all HYATT inner races are made from nickel alloys of the carburizing type. They permit the simplest kind of mountings and lowest overall cost, and their shoulders will withstand considerably greater impact loads than those of through-hardened races.

THE RECOGNIZED LEADER IN CYLINDRICAL BEARINGS

1908–1958

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

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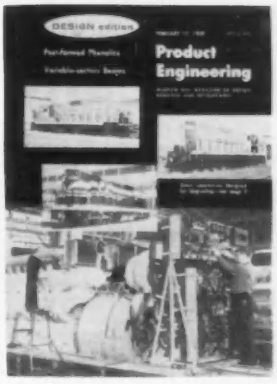
Interesting to Note . . .

Tom Thumb



Down through history, people will remember such races as Bannister's under 4-minute mile, Whirlaway's winning the '41 Kentucky Derby in record time, or perhaps Sheridan's race to Winchester. How many will remember a summer day in 1830 when *Tom Thumb* raced a horse-drawn railroad car? Peter Cooper, New York inventor and engineer, built *Tom Thumb*—the best-known early locomotive. It had a vertical boiler made of musket barrels because iron pipe was not available. With one cylinder, it could develop about one horsepower, and weighed one ton.

"The railroad is nothing but a toy" . . . "She'll never replace the horse." So went the talk of the day. Then on a double-track section of the new 13-mile line between Baltimore and Ellicott's Mills, B&O's *Tom Thumb* was returning to Baltimore when a horse-drawn car pulled up on the adjoining track. And the race was on. Under full throttle, *Tom Thumb* seemed to be a sure winner. Close to Baltimore, the belt driving the blower slipped, steam pressure dropped, and the train stopped—but with glory. *Tom Thumb* became the most celebrated loser of the day—the railroad came into its own. Within several months, the *Best Friend of Charleston* became the first train to operate on a schedule. It also was the first locomotive to blow up. A fireman didn't like the way the safety valve hissed at him, so he held it down. Because the valve couldn't blow, the boiler did.

Some of these old relics are housed in museums, others are remembered only in books. What happens to the old locomotives of today? As shown on our cover and described on page 78 they are revitalized and go right on earning their keep.

Marco Polo's Gift to the Orient

Perhaps the greatest ambassador of all times was Marco Polo. After his visit to the Orient, the western world was introduced to such items as block-printing, gunpowder and spaghetti. His eastern wanderings were not entirely one-sided. For although Marco Polo learned a great deal from the Orient, he left the East with a touch of western culture. One artifact was an Irish piece of gold, coated with a vitreous enamel.

The actual origin of enameling is lost. It is known that the Celts and Saxons had enameled gold and bronze ornaments.

(Continued on page 7)

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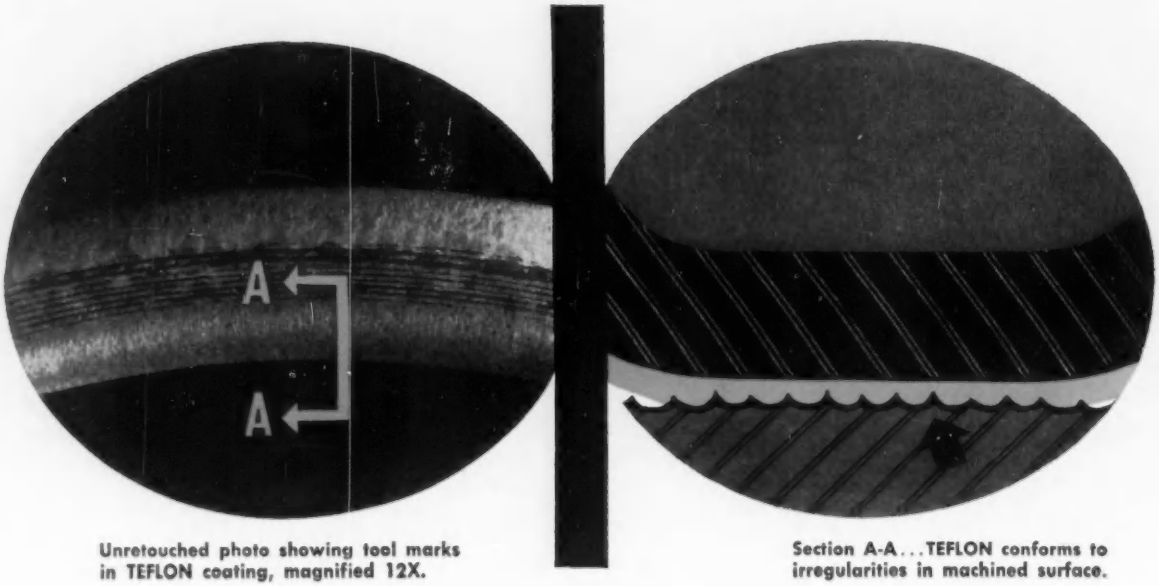
Magnified 12X reveals why Teflon* coated

UNITED METALLIC O-RINGS...

are the *perfect seals* for

LIQUID NITROGEN • LIQUID OXYGEN • AIR • FUELS



Unretouched photo showing tool marks in TEFLON coating, magnified 12X.

Section A-A...TEFLON conforms to irregularities in machined surface.

The 12X magnification proves that *Teflon*, permanently bonded to a United Metallic O-Ring, conforms to normal tool marks which it contacts in a machined seat. These microscopic valleys and ridges are exactly reproduced in reverse on the *Teflon* coating, as shown in photograph. This remarkable, non-porous, pliable coating compresses into these irregularities to help form a perfect seal.

United Metallic O-Rings, when *Teflon* coated, retain the spring steel characteristics of the metal, and provide the added advantage of the surface conformability of a rubber-like compound. Finish is completely non-corrosive and resistant to chemical action.

Extensive tests involving gases and liquids, at both high and low pressures, prove the absolute sealing action of *Teflon* bonded to stainless steel type 321 O-Rings. Tests included liquid nitrogen to —321° F. and hot air to +600° F. *Teflon* coated O-Rings are recommended for simple V-clamp installations, where they reduce the amount of compression-load required to make a positive seal.

United Metallic O-Rings may be made to practically any required dimensions.

Write for complete information.

*Teflon is the registered trademark for DuPont tetrafluoroethylene resins.

UNITED METALLIC "O" RING CORP.

Dayton, Ohio • Box 1035

Division of United Aircraft Products, Inc.

Interesting to Note . . . . *(continued)*

Enameled jewelry was also found in ancient Egypt and Assyria. It was quite a step from jewelry and works of art to commercial work, but a family in Czechoslovakia, the Bartelmes, were probably the first to try it. In 1830 they started with cast-iron cooking ware, and enameled the interior. They almost met defeat because of the lead in their enamel. Thirty years later, the same family started to enamel sheet iron—the birth of a great Central European industry.

The use of enamels has spread tremendously. Today, you can even buy a porcelain tombstone. On page 75, an article describes the design features of porcelain coatings on steel.

A Salt and Battery

On a London street corner 150 years ago, two chemists met accidentally. Words were spoken and both mysteriously withdrew to a secluded alleyway. One of the men took a tailor's thimble from his waistcoat pocket and proceeded to fill it with the contents of a small vial. To his companion's amazement, the galvanic arrangement within the thimble, plus the saline solution, produced a tiny battery capable of turning a platinum wire white-hot. Today, of course, there are dry batteries small enough to power a wrist watch. (Apr. '57, p. 156) Further applications of dry cells are discussed on page 72. However, the thimble battery of William Wollaston was indeed a milestone.

Wollaston is not remembered as an electrical pioneer, but as the discoverer of the element palladium. He was working in his lab trying to find a method of rendering platinum malleable so that it could be made into evaporating vessels to contain sulfuric acid, when his experiments went awry. Instead, he found a substance he called *palladium*, from the asteroid, *Pallas*, discovered the same year.

To establish a prior claim to the discovery, he announced the metal anonymously and sold samples through a natural-history shop kept by his friends. His discovery was questioned and, again anonymously, he offered 20 pounds to anyone who could make 20 grains of palladium. The award was never claimed.

> PALLADIUM; OR NEW SILVER, has these Properties amongst others that shew it to be a New Noble Metal . . . It Is Sold Only by Mr. Forster, at No. 26, Gerrard Street, Soho, London. In Samples of Five Shillings, Half a Guinea, and One Guinea each.

Lament of the Open Road

Driving a car in any of our large cities is about as pleasurable as maneuvering through a cattle stampede. Not only does the driver have to keep alert to the pedestrian menace, but local cab drivers, feeling an inert sense of belonging, have awarded themselves right of way over all—even large buses. Drivers in some cities have perfected the honk-and-go technique. At an intersection, he who honks loudest has the right of way. Naturally, this system has its drawbacks, but most drivers and cars are covered by insurance.

Next to driving in a city, the most difficult dilemma arises as soon as an operator wants to leave his car in favor of an ancient pastime—walking. In New York, street parking is virtually out of the question. It is discouraged by a fine of $15 for parking overtime, compared with $10 for parking by a fire hydrant or $5 for going through a red light. The only answer is a high-priced garage. The Automobile Manufacturers' Association reports that in 1956 there were 67¼ million cars in this country and 8½ thousand public garages or parking lots. This is roughly one garage per 8 thousand cars.

Most modern garages are able to cope with the flood of autos by squeezing them into multilayered buildings or placing them so close together the doors will open only enough to permit a small, thin midget to squirm through. The Italian firm, Alfa-Romero, has designed a car, shown on page 81, with sliding doors that could make an attendant's job a little easier. One of our editors tells us that in Monterrey, Mexico, parking lots employ small boys who run atop parked cars and through open windows to enable attendants to squeeze an extra car onto the lot.

Snake Snatching

Two men walked easy on the hot Texas prairie. Between them they shouldered a five-foot aluminum pole with a canvas sack swinging from the center. The lead man stopped abruptly as a familiar sound stirred the air. Slowly the men lowered the sack, and the front man, pole in hand, walked three paces, then stopped. On a flat rock, not four feet away, a large diamondback rattlesnake basked in the noonday sun. Coiled in readiness with buzzer buzzing, the snake suddenly found itself lassoed with no means for counterattack. At one end of the aluminum pole, the hunter; at the other, hanging from a looped wire, his prey.

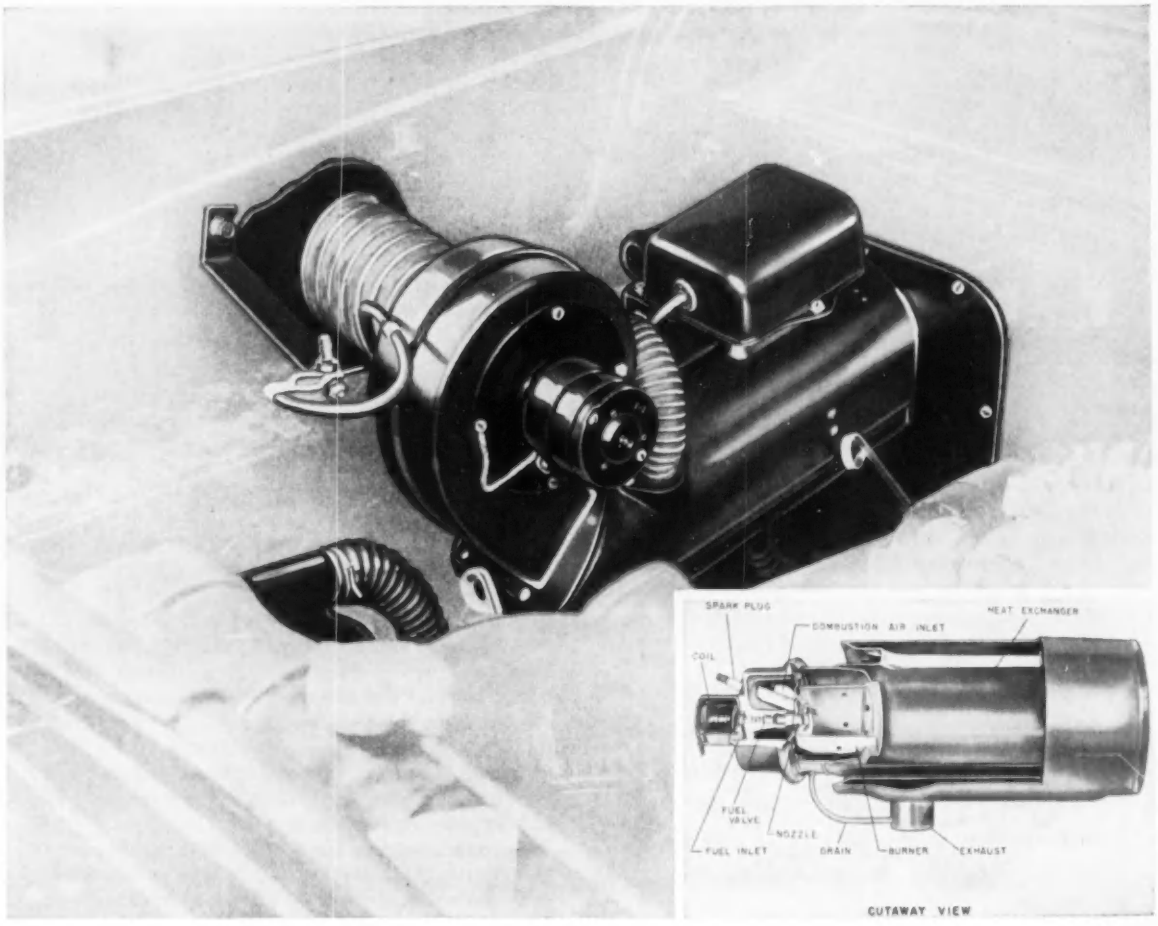
Snake snatching demands the best from an aluminum pole. For those who require the best from an aluminum casting, the article on page 69 will be of interest. Uses of aluminum are many, but who uses rattlesnakes? Today venom is used for research and snake-bite serum; the snake itself ends up as a sport belt or perhaps on a gourmet's table. Our staff gourmets say it tastes like chicken.

Many years ago, when buffalo hunters crisscrossed the prairies, the mark of a man was not how he held his guitar but how he held his liquor. Following the buffalo trains would be a mule-drawn buckboard with barrels of home made brew. Saturday night, the hunters would gather and test their ability to hold the vilest concoctions imaginable. One "brewer," Rattlesnake Ned, advertised and sold "Rattlesnake Juice." He was run out of camp when it was actually discovered that part of his ingredients were four fresh rattlesnake heads.

—Benedict A. Leeburger

Problem-Solving Products from Republic

RESIST HEAT AND CORROSION, INCREASE STRENGTH/WEIGHT RATIOS



CORROSION AND HEAT PROBLEMS were solved in this car heater with the help of Republic ENDURO® Stainless Steel. The gasoline burning heater is manufactured by South Wind Division of Stewart-Warner Corporation, Indianapolis, Indiana.

The unit is equipped with its own spark plug and fuel pump which ties into the car's gas line just ahead of the regular fuel pump. The spark plug ignites the gasoline which burns with a continuous flame for regulated periods of time. Thermostatically controlled and rated at 30,000 BTU's, the heater will deliver warm air in five seconds and 180° temperatures in 30 seconds.

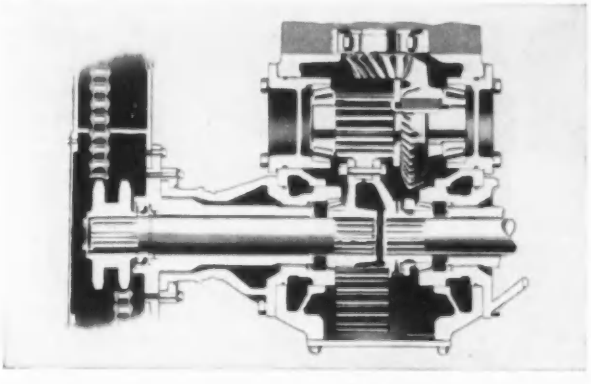
ENDURO Stainless Steel, Type 430, was selected for the combustion chamber and surrounding housing because of its low thermal expansion and resistance to corrosion and oxidation at high temperatures (up to 1400°F).

Still another advantage of ENDURO, Type 430, is that it can be readily formed into desired shapes by rolling, bending, pressing, drawing, etc. Its properly prepared surface shows good resistance to atmospheric attack and tarnishing which accounts for its widespread use as molding and decorative trim sections.

Type 430 is but one of more than 35 standard types of stainless steel produced by Republic. Our metallurgists and engineers are always available to work with you in selection, application and processing. Just mail the coupon. There is no obligation.

FOR MAXIMUM SUPPORT, National Seating Company uses Republic ELECTRUNITE® Mechanical Tubing in their "cradle recline" passenger seats. The seat is mounted on 1" O.D. square ELECTRUNITE, bent to a 45° angle for styling. High ductility and superior strength-to-weight ratio of ELECTRUNITE make this operation possible. Rear legs are of ½" x 14-gage round tubing. Besides structural and ornamental advantages, steel tubing eliminates the danger of accidents caused by sharp-edged structural members. Send coupon for complete details on ELECTRUNITE.

OUTSTANDING CORROSION-RESISTANCE even after deep-drawing is provided by Republic Continuous Galvanized Steel. Under the toughest manufacturing conditions the zinc coating will not crack, flake or peel in any forming operation permitted by the base metal. That's why Mackenzie Muffler Company, Inc. uses it in fabricating mufflers for cars, trucks and tractors. Republic Continuous Galvanized cuts manufacturing costs, too. It eliminates costly hot dip operations. Permits continuous uninterrupted production. Available in a wide range of sizes, gages and grades in sheets or coils. Mail the coupon for complete facts.



EXCEPTIONALLY HIGH STRENGTH-TO-WEIGHT RATIOS plus resistance to fatigue, stress, shock and impact are values of Republic Alloy Steels that equipment builders have been relying on for years. Engineers and metallurgists of the Adams Division, LeTourneau-Westinghouse Company, for example, spent thousands of hours on research and testing of all types of steels to find one that would reduce ultimate fatigue to an absolute minimum in the drive axle of their "660" Motor Grader. They selected Republic Hot Rolled 4340 Alloy Steel. This fine steel not only resists fatigue, but also is able to take high torque without a permanent set. Specify Republic Alloy Steels where strength and toughness must resist heavy-duty roughness. Our metallurgists will help you.

REPUBLIC STEEL

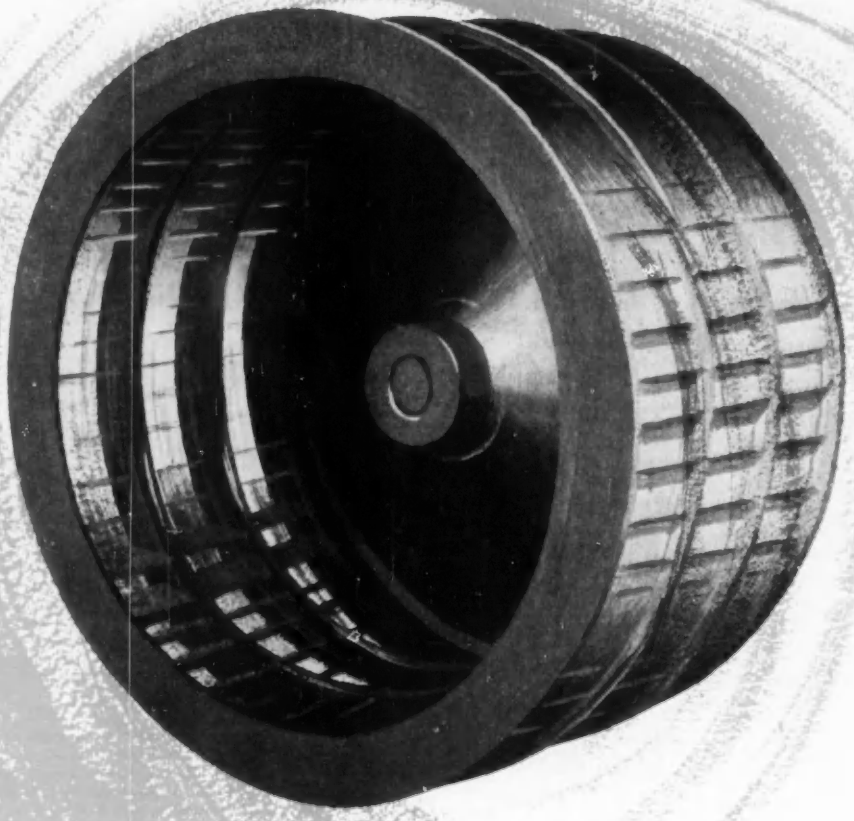
World's Widest Range of Standard Steels and Steel Products

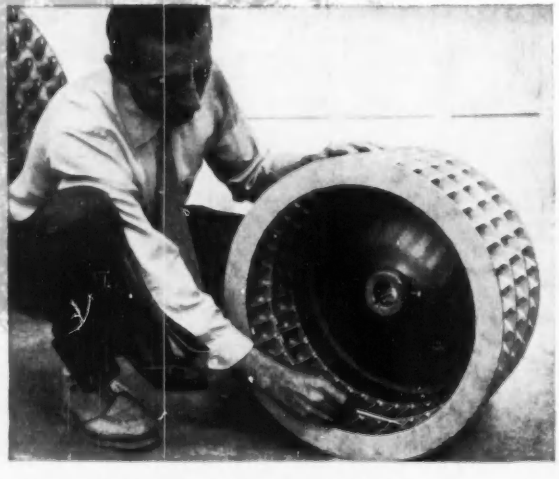
REPUBLIC STEEL CORPORATION
DEPT. C-5124
3150 EAST 45TH STREET • CLEVELAND 27, OHIO
Have a metallurgist call: ☐ Stainless ☐ Alloy
Send more information on:
☐ ENDURO Stainless Steel
☐ ELECTRUNITE Mechanical Tubing
☐ Continuous Galvanized Steel ☐ Alloy Steels

Name_____ Title_____
Company_____
Address_____
City_____ Zone____ State_____

HEAT • WEAR • CORROSION

HAYNES Alloys solve the



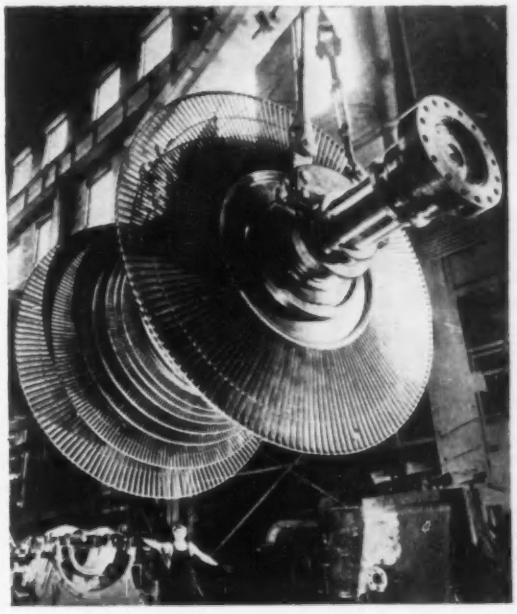


HEAT

10 Years' Service at 1600 to 1800 deg. F.

Rotors and impellers made of MULTIMET alloy are being used to circulate the atmosphere inside heat-treating furnaces where temperatures range from 1600 to 1800 deg. F. They are expected to last 10 years even though they are exposed to both reducing and oxidizing conditions.

tough problems



EROSION

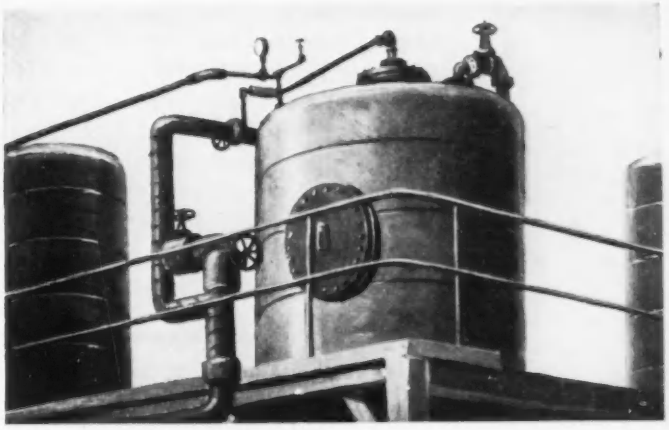
Withstands High Velocity Erosion for 19 Years

Blading at the cold end of steam turbines spins at speeds approaching that of a high speed bullet. At these high velocities even small water particles can cause rapid wear on most metal parts. Yet when the leading edges of these blades are protected by a 27-in. strip of HAYNES STELLITE alloy, they remain in operation up to 19 years!

HAYNES alloys give long, dependable service under some of industry's toughest conditions. They operate for long periods of time at temperatures up to 2000 deg. F; they resist the severe corrosive action of many chemicals; and they withstand the wearing effects of abrasion and erosion.

There are over 100 HAYNES alloys—a wide selection that practically guarantees you a tailor-made solution to your heat, abrasion, or corrosion problems. Many of these alloys are available as sheet, plate, bar stock, tubing, wire, sand castings, investment castings, welding rods, hard-facing rods, and metal-cutting tools.

For complete details on properties, prices, and forms, write for literature, or contact our nearest sales office... HAYNES STELLITE COMPANY, Division of Union Carbide Corporation, Kokomo, Indiana. Sales Offices in Chicago, Cleveland, Detroit, Houston, Los Angeles, New York, and San Francisco.



CORROSION

Resists Chlorine Compounds at 300 deg. F.

Vessels lined with HASTELLOY alloy C last from 2 to 4 years while handling such severely corrosive media as hydrochloric acid, tri-chlor benzene and other chlorine compounds. Because of the unusual resistance of HASTELLOY alloy C to a variety of corrosives, it is widely used in the Petroleum, Chemical Processing, Metalworking, and many other industries.

HAYNES
ALLOYS

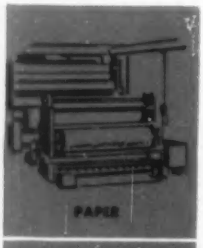
HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

"Multimet," "Hastelloy," "Haynes," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

DYNAMATIC®

Eddy-Current and Solving Problems



If you want to Drive, Stop, Test—Control Speed, Torque, or Tension — Dynamatic Equipment will do it Better at Lower Cost!

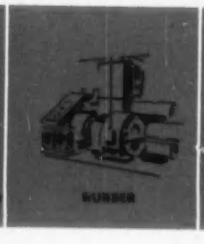
Dynamatic Eddy-Current Couplings, Drives, Brakes, and Dynamometers—

fulfill practically all stepless adjustable speed and testing equipment requirements, using standard alternating current as a power source. This Dynamatic torque transmitting equipment, with electronic or magnetic amplifier control, offers a long list of outstanding advantages: rapid response, wide speed range, quiet operation, low power loss, low maintenance cost, and remote control. There are types and sizes of Dynamatic Eddy-Current Equipment for every industrial requirement, including compact drive-package combinations *(illustrated at the right)*.

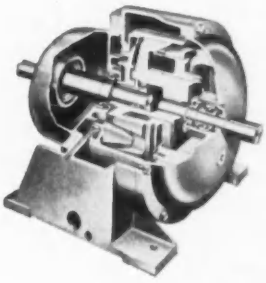
Dyna-torQ Magnetic-Friction Clutches, Brakes, Clutch-Brakes, and Clutch-Couplings—

provide the accurate trouble-free method of controlling power and motion in modern stop-and-go machines. Eaton Dyna-torQ units utilize a simple operating principle which provides instant response, shockless acceleration and deceleration. Superior construction means long operating life, minimum down-time, low maintenance cost. Outstanding advantages include rapid engagement and disengagement, self adjustment, lower operating temperature through effective cooling, simple accurate control. There is a wide range of sizes and capacities.

Send for Illustrated Literature Describing
Dynamatic Eddy-Current and Dyna-torQ Equipment



Magnetic-Friction Equipment is in Every Major Industry

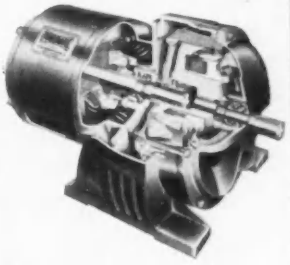


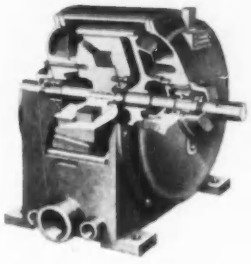
EDDY-CURRENT COUPLINGS

Dynamatic Eddy-Current Couplings transmit torque from driving to driven member without mechanical contact, shock, or friction. Controls provide infinitely adjustable speed from a constant speed source or constant speed from a variable speed source with smooth, controlled acceleration. Liquid-cooled and air-cooled types.

EDDY-CURRENT DRIVES

Dynamatic Eddy-Current Drives consist basically of an integral combination of an AC constant speed induction motor and an eddy-current coupling. Electronic or magnetic amplifier control provides accurate speed control for a wide range of applications. Available in liquid-cooled and air-cooled types.



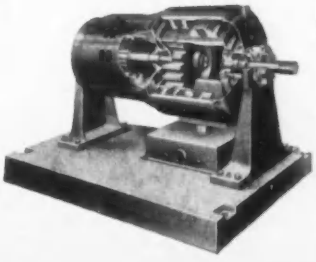


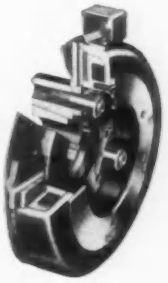
EDDY-CURRENT BRAKES

Dynamatic Eddy-Current Brakes are available in a wide range of torque capacities and operating speeds. Features include smooth, frictionless, shock-free operation with no rotating electrical components or contacts. Liquid-cooled and air-cooled types.

EDDY-CURRENT DYNAMOMETERS

Three types of Dynamatic Eddy-Current Dynamometers are available to meet various testing requirements; absorption dynamometers up to 15,000 HP; motoring or driving dynamometers up to 500 HP; and universal dynamometers to 500 HP and larger. Special purpose dynamometers are also available.



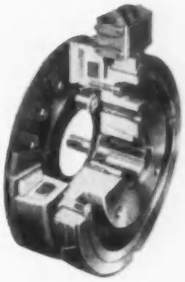


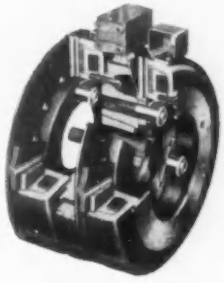
DYNA-TORQ BRAKES

Dyna-torQ Brakes provide controlled deceleration and positive stop with a touch of the control. Rapid, shockless stopping of rotating machine parts reduces interval between operations, and positive holding keeps them motionless between cycles. Compactness and remote control mounting conserve space.

DYNA-TORQ CLUTCHES

With the Dyna-torQ Clutch close control of clutch torque provides soft, cushioned starts, minimizing shock. Driving motors may be brought to operating speed before coupling to the load. Soft clutching permits controlled acceleration.



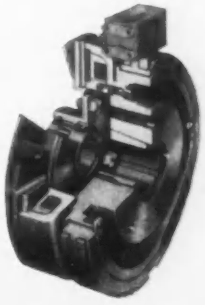


DYNA-TORQ CLUTCH-BRAKES

The Dyna-torQ Clutch-Brake provides closely controlled acceleration and deceleration. It is ideal for applications requiring automatic start-stop operation, eliminating time loss in slow-down between operations, and facilitating accurate automatic cycling.

DYNA-TORQ CLUTCH-COUPLINGS

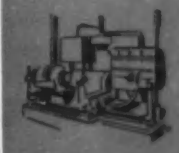
Compact, simple, Clutch-Coupling parts are installed on shaft ends in the same manner as the halves of a conventional flexible coupling. Designed for clutching of directly-aligned shafts, the Dyna-torQ Clutch-Coupling is easily installed on existing machinery or designed into new equipment.



DYNAMATIC DIVISION

EATON MANUFACTURING COMPANY

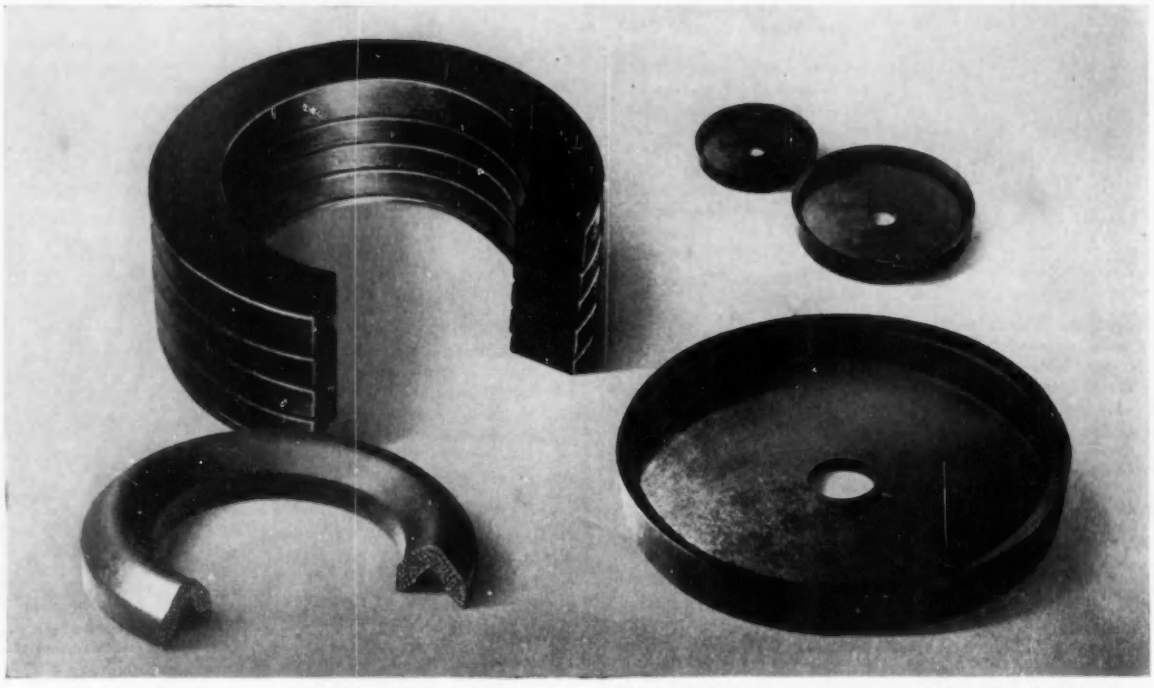
KENOSHA WISCONSIN



CUT COSTS, IMPROVE DESIGN AND PERFORMANCE WITH R/M PRODUCTS

PACKINGS

Complete information on packings shown and many others is given in free booklet. Send for it today.
Packing Division, Raybestos-Manhattan, Inc.
Passaic, N.J.



R/M Vee-Flex Rings seal automatically and will not roll.

R/M Fabric Piston Cups are precision molded and cleanly trimmed.

Precision quality control means you can rely on R/M V-rings and piston cups

R/M Vee-Flex Rings give better performance and cut maintenance costs. Convex curvature of the surface which touches next ring makes them self-sealing, self-adjusting. Pressure stroke produces a seal against stuffing box wall and adjacent ring. Friction is reduced on return stroke. Precision molded and trimmed for best possible fit. Fabric is deeply penetrated by compound for longer wear. Use them on steam or air rods, hot oil pumps, hydraulic rams, outside-packed plunger pumps, food handling machinery, accumulator and elevator rams on oil or water service.

R/M Fabric Piston Cups provide minimum friction, long life, and accurate fit. Molded from a variety of rubber synthetics with fabric reinforcements to suit your specific requirements. See the big difference: clearly defined contours and cleanly trimmed edges—proof of strict adherence to industry standard sizes. R/M Fabric Piston Cups fit hydraulic and pneumatic cylinders ranging in diameter from ½ to 12 in. They are produced in varying degrees of hardness for pressures up to 1500 psi and in compounds to meet your specific operating conditions.

The complete R/M line includes packings and gasket sheets for use with gases, water, steam, oil, chemicals, solvents and food products. Feel free to call on R/M's experienced engineers for help in your packing problems.

R/M

Brake Blocks, Linings and Clutch Facings

Mechanical Packings and Gaskets

Abrasive and Diamond Wheels

Industrial Drive Belts

Industrial and Automotive Hose

Conveyor Belts

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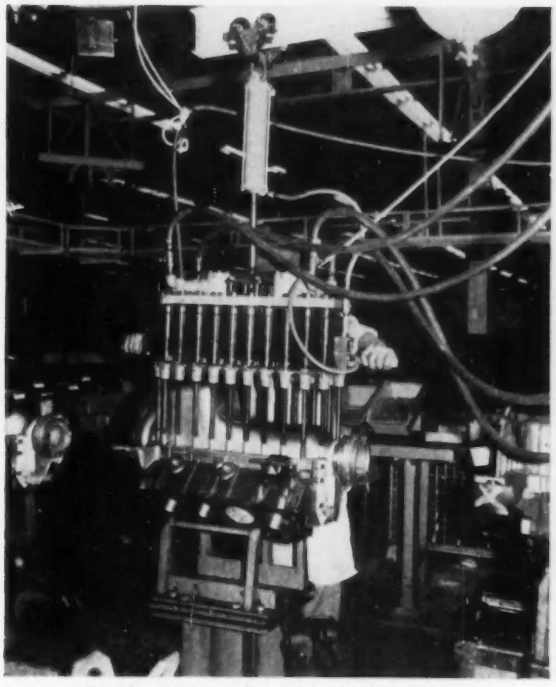
Write today for free booklet shown: full details on a wide variety of industrial rubber products.
Manhattan Rubber Division, Raybestos-Manhattan, Inc.
Passaic, N.J.

PLASTICS

Write for free booklet, which provides valuable information on a variety of R/M plastic products.
Plastic Products Division, Raybestos-Manhattan, Inc.
Manheim, Pa.



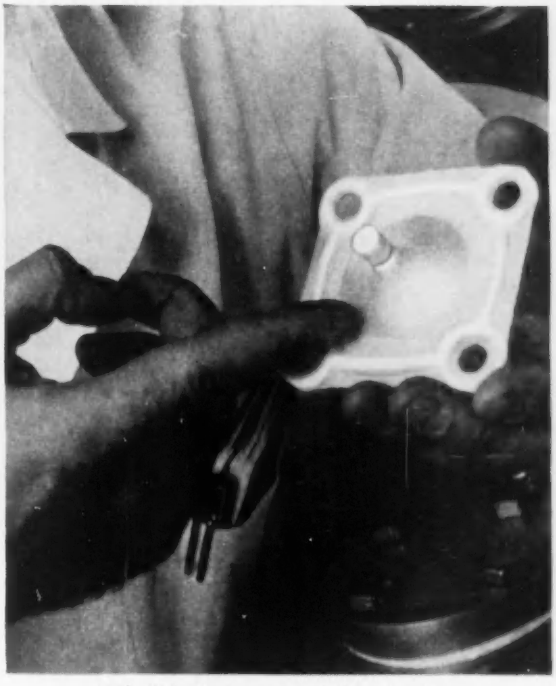
Homoflex Hose, manufactured by Manhattan Rubber Division, is engineered for use on air-driven tools.

R/M Hose engineered for many purposes

For general use with air, water, gases . . . special types for handling oils, acids, chemicals . . . or non-spark, high heat or non-contaminating construction—R/M has a rubber hose for *every* application.

For example, *Flexlon* R/M rubber hose, "Teflon"* lined, offers complete resistance to virtually all chemicals and solvents. *Allflex* is a versatile all-purpose hose for handling fluids and gases—even mild chemicals. *Homoflex*, lightweight and easily handled, is ideal for air tools. *Super-Master BW* Burstproof Steam and Air Hose has special wire braid reinforcement for rugged, high pressure service.

R/M also makes flanged flexible pipe and rubber expansion joints. Whether it's hose, transmission or conveyor belts, V-belts, Poly-V Drive® or molded rubber products, depend on R/M's 60 years of leadership in rubber.



"Teflon" diaphragms protect Salk vaccine from contamination during long manufacturing process.

R/M "Teflon" Valve Diaphragms protect purity of polio vaccine

Salk polio vaccine must be kept absolutely pure and sterile during the 130 days needed to manufacture and test it. To help guard against contamination, valves are sealed with thin, long-lasting diaphragms of "Teflon," developed by Raybestos-Manhattan. "Teflon" is ideally suited for this exacting application. It is strong, flexible, chemically inert, easily sterilized, and well able to withstand the required temperatures, ranging from 5 to 150°C.

Many other R/M "Teflon" products are also at work for aviation, missile, electrical and electronic industries. Among these are flexible thin-wall tubing (plain or covered); tape; custom-machined parts; rods and gaskets; expansion joints and flexible couplings; bondable "Teflon" sheet and other products. Raylon, an R/M mechanical grade of "Teflon," has many of the characteristics of virgin "Teflon."

*A Du Pont trademark

RAYBESTOS-MANHATTAN, INC.

FACTORIES: Passaic, N.J. • Bridgeport, Conn • Manheim, Pa. • Paramount, Calif. • No. Charleston, S.C.
Crawfordsville, Ind. • Neenah, Wis. • Peterborough, Ontario, Canada

Rubber Lined and Covered Equipment

Sintered Metal Friction Elements

Asbestos Textiles

Industrial Adhesives

Teflon Tape, Packings, Sheets, Rods, Tubes

Engineered Molded Rubber and Plastics

Scrivener's Parking Building, Baltimore. Aluminum paneling is treated with beautiful Bonderite Architectural Green.

sheathed in aluminum . . . and protected by

Bonderite Architectural Green

You'll see many more buildings, like this attractive structure in Baltimore, using aluminum finished with Bonderite Architectural Green. There are so many things to recommend this beautiful, durable Bonderite coating!

Treatment with Bonderite Architectural Green protects aluminum from corrosion. The same protective treatment chemically produces a soft, lasting green color which is a part of the integral coating of the metal surface. Color is sun-and-weather-fast.

Bonderite Architectural Green costs far less than electrolytically produced color coatings for aluminum. It is simple to use, and the color uniformity is a sure visual check on the uniform quality of the coating, maintained in volume production day in and day out.

Bonderite Architectural Green may be applied by spray or immersion, and by continuous strip treatment.

Metal treated in this manner can be used not only in construction panels, but also for siding, awnings, venetian blinds and many items on which the excellent color and durability contribute to a better, more salable product.

Write for descriptive illustrated booklet "Bonderite 700 Series". Details on Bonderite Architectural Green, uses, advantages, characteristics.

Since 1914— leader in the field

PARKER RUST PROOF COMPANY
2179 E. MILWAUKEE, DETROIT 11, MICHIGAN

BONDERITE	BONDERITE and BONDERLUBE	PARCO COMPOUND	PARCO LUBRITE	TROPICAL
corrosion resistant paint base	aids in cold forming of metals	rust resistant	wear resistant for friction surfaces	heavy duty maintenance paints since 1883

*Bonderite, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.

DEVELOPMENTS TO WATCH...

First independent commercial center . . .

. . . for radiation processing and research is going into operation in Rockford, Ill. Equipped with an Applied Radiation Corp. 8 mev (2.3) linear accelerator, Midwest Irradiation Center, Div. of W. F. & John Barnes Co., will process materials, irradiate research samples, or simply rent its facilities at a contract price of $100 an hour. The center will make it possible to explore the effects of radiation in strengthening materials, increasing heat resistance, minimizing wear. Firm prices will also be quoted on job-lot processing of products (plastics parts, for instance), according to the Barnes Co. announcement.

High-strength paper that conducts electricity . . .

. . . is being produced experimentally by Hurlburt Paper Co. The fibers are metal filaments instead of wood, or combinations of metal, glass, and synthetic fibers. In appearance, these metal-fiber papers resemble foil. But, in properties, they are much closer to cellulose paper, and are being processed on paper-making machines. However, as Dr. Hanns F. Arledter, Hurlburt's director of research, points out, commercialization is "at least one to three years away."

Metal-fiber paper is by no means the only new type now being developed (for information on others, see Jan. 9 '58, p. 34; and Jan. 27 '58, p. 17); and paper is not the only new use for metal fibers. Horizons, Inc, for instance, is experimenting with felting techniques as a replacement for powder-metallurgy processes in producing complex porous shapes that will retain their strength and ductility at high temperatures. At Horizons, the fibers are obtained by a wire cutting or shaving process. A fiber slurry is then made up and fed to a porous die. The liquid is removed by vacuum suction, and a part conforming to the die surface is produced. This can then be sintered and rolled or otherwise processed in the usual way. Horizons is also working on fiber-powder combinations and fiber-resin mixtures, using commerically-available metal (bronge, iron, aluminum, stainless) fiber wools in some cases, and a processing technique that involves vibration of the fibers and vacuum filling of the resin. Filters produced this way, Horizons says, "show considerable improvement over conventionally formed filter elements in strength properties." This improvement is especially notable at high temperatures.

New light on color specification . . .

. . . is provided by two new Eastman Kodak devices: one, a digital tristimulus integrator; the other, a portable color-measuring device. The integrator, built for use with a spectrophotometer, evaluates colors under a variety of lighting conditions (fluorescent, incandescent, daylight). Tristimulus integrators are not in themselves new; but the portable color comparator (see photograph) is said to be the first of its kind. It can be used in- or outdoors, will measure color close up or at a distance.

Neither device is to be manufactured for sale; but both are expected to provide more information on how the eye sees color, and how color can best be recorded to create a visual photographic image that matches the individual's perception of the original scene.

Portable, telescopic colorimeter uses additive color-matching, employs filters (foreground) to compensate for visual variations. To check close-up object like TV screen, plastic tube (leaning against box) replaces telescope.

DEVELOPMENTS

TO WATCH...

At 500 to 1000F, oil is not needed . . .

. . . on metal bearings Shell Development Co. scientists report. The metal does need protection, but this they say, can be provided by hydrocarbon vapors—without the use of oils or greases. They've found that, after an initial run-in with oil, tool-steel roller bearings will operate at high temperatures for at least 100 hr if surrounded with a hydrocarbon vapor. Extreme-pressure additives, usually supplied by the lubricant, are still needed, but they can be fed to the bearing by the protective vapor. Furthermore, the Shell scientists say, at least one jet-engine fuel (JP-4) can serve very well as the hydrocarbon atmosphere, and will combine with the additives to form a good lubrication film on the bearing surface.

Two new coated products:

Aluminum-coated steel wire is another new material soon to reach the market. U. S. Steel Corp. is aiming it at applications now held by galvanized metal—initial target: barbed-wire fences. American Steel & Wire Div. says the new wire is "virtually free of progressive corrosion—even after 5 yr in the field. Strangely, although the coated wire starts out with a silvery sheen, it turns to a soft golden color after a few weeks of use. AS&W will produce it in diameters of 0.06 to 0.11 in.

Copper-plated aluminum strip in widths up to 10 in. and thicknesses 0.008 to 0.050 in. will soon be available commercially as a result of a new process developed by Sylvania Electric Products, Inc., 12 Second St., Warren, Penna. Sylvania engineers say they can deposit a coating as thin as a flash or as thick as 0.002 in. on a side. Primary applications for the material are expected to be in printed circuits, bus-bar conductors, and other electrical and electronic equipment.

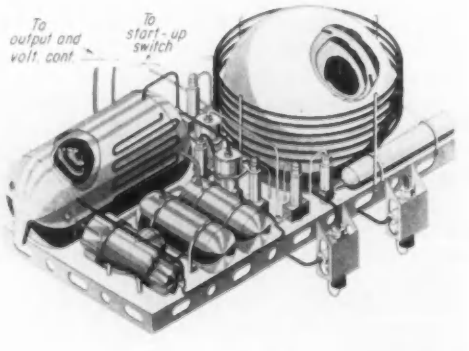
300 watts of portable power . . .

. . . 110 volt 60-cycle is made available by a new ac battery developed by Yardney Electric Corp., 40-50 Leonard St., New York 13. Yardney plans to introduce the unit at the IRE show in March. The new power package includes a 15-volt silver-zinc battery and a transistor converter, said to be 80 to 90% efficient. It weighs 20 lb, takes about 9 cu in. of space, can be recharged from 110-volt ac outlet.

Fuel cells with an efficiency of 70 to 80% . . .

. . . are in development at Patterson, Moos Div., Universal Winding Co., Jamaica, N. Y. These are hydrogen-oxygen cells, using nickel electrodes and a potassium-hydroxide electrolyte that "convert the chemical energy of hydrogen directly into electricity" (Sept. 23 '57, p. 8), and they're remarkably compact and powerful. One of PM's models has a total weight of less than 100 lb, complete with fuel. It will operate for 6 hr at its rated capacity of 1.5 kw, and can deliver 3 kw under overload. The complete power package is just 28 by 16 by 14 in. That means an output-to-volume ratio of nearly 3 kw hr/cu ft, and PM points out that doubling the gas-storage capacity would not markedly increase over-all size of the unit, so there is plenty of opportunity to increase that ratio.

Though the unit described here is being designed for the military, and no commercial models have as yet been built, PM engineers estimate that it should be possible to produce commercial cells at a price competitive with lead-acid batteries, and for possible use in such equipment as industrial trucks. —ARG



Fuel-cell power package includes gas-storage container (right), operating controls (foreground). Cell itself is at left. Recharging is just a matter of refilling hydrogen and oxygen containers Patterson, Moos points out.

Production may be Down, But Not R & D

NEW YORK—While pundits pondered the recessive state of the US economy this week, PRODUCT ENGINEERING via McGraw-Hill News Bureau polled industry from coast-to-coast on the subject of R&D budgets for 1958-59.

The question: are such budgets being decreased, increased or maintained on status quo?

The answer: R&D budgets will generally suffer only slightly and these will be isolated cases; in fact, the majority will stay the same while many will be upped in order to reestablish strong positions in the market.

Midwest – Of 22 manufacturers queried in the state of Michigan, 10 revealed that their R&D budgets would remain unaffected. Notable amongst these was the automotive "Big Three" who, while not allowing there is a recession in progress, gave the general impression that budgets for this and next year stand firm. However, in the case of Ford Motor, R&D phases deemed frilly are being eliminated from budgets.

Another eight, mostly major corporations, announced they would increase their R&D budgets despite any pessimistic economic outlook. Typical reply here to our queries was offered by K. B. Hollidge, Arthur Colton Co. vice president: "In times of lower business volume we seek to increase our R&D budget since we know it will improve our market position."

Only four companies reported a planned reduction of R&D—one expected to reduce by 20%, two said only slightly and the fourth said a substantial amount. Pioneer Engineering & Manufacturing Co. Pres. Michael Pinto said: "The current business drop affects a lot of R&D programs, particularly those companies that are just getting such programs off the ground. For the small company R&D is often too expensive when you're struggling just to exist."

In Cleveland one firm reported that its R&D budget must be scaled to gross profits—hence a marginal R&D budget cut. Another, Harshaw Chemical Co., revealed that its research expenditures for the first quarter of 1958 as opposed to the first quarter of 1957 had risen 10%.

West Coast—Out here they don't think in terms of recession, and particularly in San Francisco Bay area. R&D budgets look to be safe for 1958-59 period. At Varian Associates, Palo Alto, Vice Pres. and General Manager, Emmet G. Cameron reported: "We'll be up 30% on R&D this year, and be more diversified."

Basis for much of the optimism is indication that government will spend more and more for defense, hence R&D is bound to benefit, providing contractors with ammunition for subsequent private industry uses.

Southwest – Generally speaking R&D budgets will continue to climb in the Dallas-Fort Worth area, assisted of course by military contracts. Texas Instruments will spend $16 million this year as against $9.5 million in 1957; Chance Vought's R&D will increase by a third during 1958. Convair's Fort Worth operations also will show a sizeable research expenditure jump.

Only Bell Helicopter figures on overall R&D dollar drop, mostly because '57 R&D is into production.

Eastern Seaboard, Southeast—Here again the R&D budgets in the main are expected to hold their own. Only in the small business structure does R&D suffer, and this is because the dollars for continuance just aren't available.

Science Conference Calls for Quality Education

NEW HAVEN, CONN.—Americans must make a bold investment in the future—if there's to be a future. They must devote a larger share of national income to the advancement of science and education.

This was the consensus of 150 top industrial leaders, educators, clergymen and scientists who gathered at Yale last week to debate the problem of mustering our human resources to meet Russia's technical challenge. The two-day idea forum was sponsored by the President's Committee on Scientists and Engineers and the William Benton Foundation.

Sputnik was generally viewed as a shocker whose significance got through to the public. Hence, Sputnik makes it possible to press for improvement in education and research that should have been made some time ago without "help" from Russia.

The mood dominating the meeting was one of deep concern over the quality of education today—a concern that was noted in all ten roundtable discussion groups that made up the nucleus of the conference.

The nation's leaders, said Dr. Waterman, Director of the National Science Foundation have an obligation to "communicate to the rank and file of people everywhere a sense of urgency about the present situation and the need to do something about it."

Basically, said Waterman, corrective forces lie in the will and attitude of the American people. "The quickest and most effective way to improve the elementary and secondary education of our children lies in the hands of their parents and the citizens of their community."

We will really know we have developed a healthier national attitude toward better education, Waterman said, when parents can honestly say they are glad their child chose a career as high-school science teacher.

Pointing out the general importance of math and science in today's world, Dr. James Killian, Assistant to the President on Science and Technology said, 'I emphasize the importance of providing our young people, whether they become scientists or not, with some of the intellectual wealth of science, some of its adventure, some of its special vision for interpreting nature—some of the understanding that our citizens should have to deal

with the great issues of our time arising out of science."

WHO PICKS UP THE BILL?

Financing the spectrum of education from grade school through post doctoral work was seen as a multibillion dollar venture—one very rough guess was $8 billion a year.

On the local level, communities will have to search for new taxes to support public schools. On the university level, many conferees felt the parents should get a bill for the full cost of their children's education. At present, university fees cover only a part; the remainder is covered by endowments.

Charging full tuition may cause hardships and will call for programs to aid needy students. There are several possibilities: the universities can refund to needy students part of the fee; scholarships can be increased; and a loan program can be developed for students. American families are used to buying on the installment plan, it was pointed out.

The universities can ask industry for help. One panelist said that industry sinks $35 billion a year into plant and equipment, but only $100 million into university research, although the universities are the ultimate source of new-product ideas.

The goal educators should set in advanced training for high-school graduates was a matter of some dispute. Some felt that universities should become more selective. Others felt education should provide a number of quality programs geared to individual capabilities.

The government's role in basic research caused considerable concern. Full utilization of research ability requires unrestricted grants made for several years. But long-term unrestricted appropriations are in deep conflict with US budgetary tradition. The control function of government is in sharp conflict with the freedom of the scientists. How much basic research the government should finance was viewed as a difficult problem.

The Committee will present to President Eisenhower an evaluation of the meetings so that the conclusions can be translated into policy. A summary of the proceedings will also be prepared for the public.

Detroit Parking Official Retorts to N. Y. Mayor's Small-Car Plea

DETROIT—Last week, Mayor Robert Wagner of New York City appealed to the automobile industry to help relieve traffic congestion by manufacturing shorter and narrower cars. His request was made in behalf of the Metropolitan Regional Conference, of which he is chairman.

John D. McGillis

By way of rebuttal, PRODUCT ENGINEERING queried John D. McGillis, Municipal Parking Authority director of Detroit, and chairman of the Committee on Parking of the American Municipal Association. Here is what McGillis had to say:

"The trend to bigger cars . . . has received the endorsement of the public that has voted for it with their dollars. If this creates problems for municipal authorities, those same authorities must solve them, but not by dictating or even trying to influence the public's buying habits.

"Foreign cars are largely smaller than ours but this reflects the standards of living existing abroad and the high cost of operating automobiles there. As these standards of living increase, foreign cars may grow bigger there too. As for curb parking, it is true that the newer 22-ft parking stalls take 10% more room than the 20-ft ones, reducing the number of cars that can be parked by a theoretical 10%; but in practice that isn't always the case. Spaces between No-Parking signs are normally short and can often accommodate the same number of 22-foot stalls as 20-foot ones.

"It comes back again to the question of proper planning, of looking ahead. In Detroit we know that the building of new expressways, expanded suburban population, and increased standards of living will continue to increase the number of cars that need to be parked in the business districts," McGillis says.

"Accordingly, not only are we capable of handling present parking needs, but we are planning off-street parking lots, new garages to handle any car traffic the next 20 years bring.

Oil for the Lamps of China Lake

NEW YORK—Three weeks ago PRODUCT ENGINEERING quoted administrative officials of the Naval Ordnance Test Station, China Lake, Calif., as objecting to the maze of red tape and objectionable policy decisions filtering through from Washington. The story pictured NOTS scientists as dedicated men seeking to work in small well-integrated groups unhampered by slender budgets.

And in passing, we referred to bad feeling between NOTS personnel and citizens of the nearest community—Ridgecrest in Kern County. This animosity was allegedly engendered by Navy permitting government-owned and operated places of business to be conducted on China Lake property. Result: Ridgecrest merchants complained of unfair competition, demanded equal opportunity to get NOTS family business.

Assured by NOTS officials that flames of friction were all but quenched, our story reported that progress in community relations was being made. This week a representative of the Kern County Property Owners Assn. testified before a House Ways and Means sub-committee investigating armed forces encroachment onto the domains of private enterprise. The Kern Countyite protested loud and long about NOTS, citing facts and figures to justify his neighbors' contention that the government was trying to run Ridgecrest merchants out of business.

All of which would appear to knock talk of a China Lake-Ridgecrest rapprochement into a cocked hat.

Launcher Trims Bomber Runway Size

WILMINGTON, DEL.—Heavy jet bombers can now streak off smaller airfields for faster retaliation missions, thanks to the updating of an assisted take-off and landing system for lighter-weight fighters. The new ATOL system was developed by All American Engineering Co. for Strategic Air Command in its aircraft dispersal program planned for the United States and overseas.

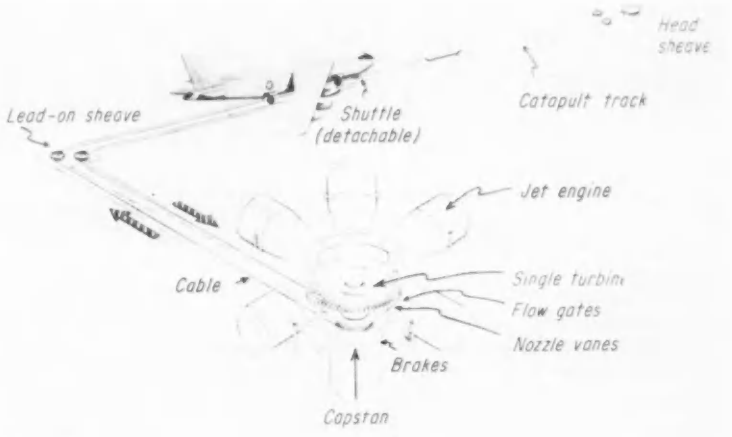
Normally, jet bombers and tankers need 12,000-ft runways for unassisted take-off and landing. With ATOL's catapult launching, they can be airborne after a run of 3000 ft, and the longest runway at a dispersal base need be only 5000 ft. The system can put nine B-52s and their KC-135 tankers into the air in less than 15 min. A "water squeezer" type cable arresting gear decelerates the plane on landing to a full stop 2000 ft after touchdown.

Big advantage of the system, says Charles W. Wendt, president of All American, is money-saving. It substantially cuts construction costs that can run $15 million to extend an average 5000-ft strip to 12,000 ft needed for heavy bomber traffic. Installation of an ATOL-600 system on a 5000-ft runway, including two catapult launching units, plus four arresting gear units and allied equipment, costs around $2.6 million. The system is also seen as a valuable time-saver in making un-expandable airports quickly operational for military use.

B-52 LAUNCHED AT 150 KNOTS

Power for take-offs is supplied by a specially designed "Turbo-Cat" energized by six Allison J-33 jet engines transmitting 50,000 hp directly to the launching cable. This catapult power, plus full engine thrust of a combat-loaded B-52, can launch the 400,000-lb plane at a speed of 150 knots.

The plane is prepared for launching by clamping small hook assemblies at forward tow points on the main landing gear. As the plane taxis from ready position to launching site, ground crewmen connect a cable bridle between the hooks and a detachable shuttle on the catapult. Acceleration forces are held to ½ G, within the structural limits of the plane.



Bird's Eye View . . .
. . . shows 6-jet capstan-drive "Turbo-Cat" that transmits 50,000 hp to cable which launches 400,000 lb bombers from small runways in rapid succession. Take-off speed (150 knots) is attained by adding "Cat's" power to full thrust of SAC heavy jets.

Secretary of Science?—Slim Hope

WASHINGTON—A bill proposing that a Cabinet-level Department of Science be created to spur education of scientists, mathematicians and engineers appears doomed.

Proposed by Senators Hubert Humphrey (D, Minn.) and John J. McClellan (D, Ark.), the bill provides for: (1) creation of standing congressional committees on science and technology; (2) a program of federal loans and loan insurance for college education in mathematics, engineering, and physical and biological sciences; (3) establishment of scientific programs outside the United States; and centralizing government research efforts.

Stumbling block is resistance to uprooting autonomy of established agencies. Under the bill's provisions, the National Science Foundation, Office of Technical Services, Atomic Energy Commission, National Advisory Council for Aeronautics, Weather Bureau, Smithsonian Institute, Patent Office and a covey of lesser groups would be administered by the new department.

Spokesmen for each of the above groups indicate they will fight any such centralization attempt. Veteran observers predict the bill will meet its stiffest test during hearings before the Senate Committee on Government Operations where pro-administration members are expected to lower the boom.

In addition to political problems, the bill raises the question of the scientist's role in government. Humphrey and McClellan feel that administration of US scientific programs should be returned to trained administrators, permitting scientists to concentrate on work for which they've been trained. But various agency heads, most of them scientists, are reluctant to relinquish authority, feeling cause of science would suffer under rein of the politically appointed.

Of prime concern to authors of the bill is retrieval of foreign-language translations. The bill would centralize indexing of technical translation, enabling responsible agencies to cross-check availability of manuscripts to avoid duplication.

The Humphrey-McClellan bill would authorize spending of $580 million in the next eight years to finance scholarship loans, and create science research institutes both here and abroad.

In another provision, the bill would junk the Joint Congressional Atomic Energy Committee (a group that has legislative powers) in favor of separate standing committees within the House and Senate. Members of this committee are expected to fight this aspect of the bill tooth and nail.

Guides for Thor Go in Production

MILWAUKEE—Inertial guidance systems for the Thor ballistic missile are in production at GM's AC Spark Plug Div. plant. The big hurdle—a method for turning out parts that will conform with the rigorous tolerances required by missile flight—is now solved.

Tolerances for some parts are measured in millionths of an inch or in tenths of a second of an arc. This level of precision makes the gyroscopes of the guidance system sensitive enough to detect movement of a wheel making one revolution every 14 years.

The systems that AC Div. now turns out, says Martin J. Cassario, managing operations in the Milwaukee area, are accurate enough to direct a space ship to the moon and back. And they are ten to 100 times more accurate than needed to put a satellite into orbit.

Guidance of missiles to an earth-bound target is considerably more difficult, he explained. He did not disclose the accuracy with which the inertial system directs a target hit, saying only that accuracy meets Government specifications.

FIRMS PUSH INERTIAL

At the same time, company R & D is pushing ahead to provide more accurate and less expensive inertial guidance systems. "The time has come," says Sherrod E. Skinner, a GM vice-president, "to get on with the job of exploring the mysteries of outer space."

Variations of the system are being developed for the Navy Regulus and the Air Force Matador. They have been tested in manned aircraft, rocket sled runs at supersonic speeds, and in ballistic missile flight including the two Thors launched by the AF last December. Missile failures, GM says, have not been a result of malfunction of the guidance system.

Inertial guidance systems continuously measure deviation of a missile from a preset trajectory and automatically turn it back on course. The system is self-contained, hence not subject to outside interference.

Airmen Want Better Instruments

NEW YORK—Aircraft pilots want help from designers. They deplore depending on calibration charts to figure out precisely how high they are or fast they are moving. They need instruments with built-in compensators that will automatically adjust for errors in measurement, according to Melvin H. Gough, of Langley Aeronautical Labs.

He told the Institute of the Aeronautical Sciences here that the increasing speed of today's aircraft sharpens the urgency for instruments that will spare the pilot from mental gymnastics. He explained the need this way:

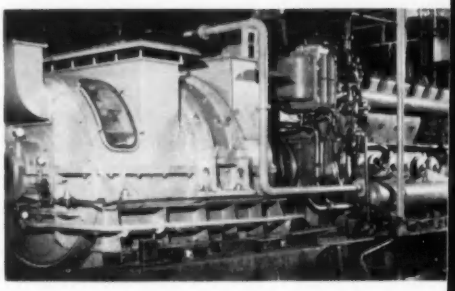
Standard military planes are now flying close to Mach 1 and commercial planes will be by the end of the year; test planes are now flying between Mach 2 and 3. At these speeds a pilot has little time to apply judgment, and his instruments generally give him only close approximations to reality. If a dial tells him he is flying at 40,000 ft, he knows only that he is close to that height—because static pressures will affect the plane and its instruments differently.

Though errors may be relatively small, Gough pointed out, they can be disastrous if a pilot, flying lower than he thinks, runs across another pilot flying higher than he thinks.

Spying Eye Goes Sky-high

NEW YORK—An electronic spy may eliminate need for manned reconnaissance patrols in missile-age warfare. Developed by Ford Instrument Co. for Army Signal Corps, it's a flying robot launched by jet-assisted take-off. It can reach a 20,000-ft altitude, stay there for a half hour, return to earth by parachute—and it can see day and night. Flight speed of the surveillance drone is over twice that of the small manned recon planes used in the Korean War. The drone, powered by a 4-cylinder piston engine, has a speed of 200 mph.

Remote-control unit for the prop-driven craft includes trailer-mounted radar station, portable manpack controller, and quarter-ton jeep. The entire unit, designed for rapid transport to forward combat areas, can be hauled by a standard Army truck.



Dry land testing . . .

of a ship's complete diesel-electric propulsion system has been demonstrated on a test stand to simulate operating conditions encountered aboard ship. Such tests usually are made after the propulsion unit is installed in the ship. Two diesel 1540-hp engines were coupled to two 1230-watt d-c generators to power two d-c propeller motors. On the test stand, which was developed by the German firm of Maschinenfabrik Augsburg-Nuernberg (MAN), the ship's propellers were replaced by water brakes to test the propeller reversing capacity and the stress on the propulsion system. Reportedly the first time such a test has been made, it was demanded by the Indian purchaser prior to shipment to the shipyard where the 3200-gross-ton ship was being built.

Requests for NSF Aid Up Since Sputnik

WASHINGTON — Since the Russians launched their first satellite, the National Science Foundation has received more than three times the usual number of requests for financial aid from individuals who want to further their scientific training.

This figure includes requests by students preparing for their doctorates and those who want aid to study to become science teachers. The National Science Foundation says requests from prospective science teachers rarely came in before.

Another large group: older persons (25 and up) who, after being graduated from high-school did not, for one reason or another, further their education. Included in this group are housewives, and mothers with grownup children. Now they want NSF assistance to attend college to become math or science teachers. NSF is considering a small program for these people.

MIDWEST NOTES:

To Compare Auto Stability

DETROIT—Taking a lead from the aircraft industry, GM has set up analog test equipment to study the stability of automobiles.

The equipment is called an automobile handling simulator, consists of a steering wheel attached to an electronic analog computer. The computer in turn connects to a servo-controlled miniature car.

In operation the simulator will enable engineers to see how a full-size automobile with certain physical characteristics would respond to a driver's handling. This in turn will supply information needed for designing steering mechanisms.

Lateral motions of an auto—yawing, rolling, or sideslipping—result from steering-wheel torque and displacement applied by the driver. Magnitude of these movements depends on car speed, length of wheelbase, steering-gear ratio, weight distribution, tire properties and suspension geometry.

Equations to describe relationship of these variables have been developed and programmed into the simulator's computer. When the computer is set for a particular auto design, it causes the miniature car to roll and sideslip as it responds to a hypothetical driver's handling of the steering wheel at speeds between 30 and 100 mph.

. . . .

Transparent epoxy resins are gaining favor as finishes for metal parts in the automotive and other industries here. They are particularly adaptable to car interiors.

When pigment or dyes are added to the epoxy, they produce transparent or opaque colored finishes with good adhesion. The cost is comparable with painting. Several companies—including Pittsburgh Paint, Egyptian Lacquer, and Grand Rapids Varnish—produce the resins.

. . . .

A $37.3 million Air Force contract for design and production of a ground guidance system for the Atlas intercontinental missile has been awarded to the Burroughs Corporation.

The contract is expected to increase the company's work force by 1000 and help ease Detroit's chronic unemployment problem.

Burroughs is already deep in defense work, holding production contracts for electronic equipment in the SAGE Continental Air Defense System and to supply components for the Titan and Thor intermediate missiles.

. . . .

Sputnik is up; college grades down. This is the word for Michigan State Univ. The school reports it is flunking marginal students now in an effort to tighten educational standards and increase the quality of its graduates.

COMING EVENTS

FEBRUARY

16-22 . . . . National Engineers' Week. Held under the sponsorship of the National Society of Professional Engineers, the events of the week are co-ordinated through 45 state societies and more than 300 local chapters.

17-18 . . . . Conference of Engineering Science Research at the Univ. of Colorado, Boulder, Colo., under the sponsorship of the National Science Foundation. Purpose is to stimulate engineering research in smaller colleges and universities.

17-19 . . . . Managing and Development Engineering Function, sponsored by the American Management Association at the Sheraton-Astor Hotel, N. Y. The seminar will analyze the development engineering function and its relationship to research and development.

MARCH

2-6 . . . . ASME Gas Turbine Power Div., Conference and Exhibit, Hotel Shoreham, Washington.

3-5 . . . . Electronics Conference and Exhibit, American Management Assn., Hotel Statler, NYC.

12-14 . . . . Pressed Metal Institute, Spring Technical Meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

17-20 . . . . ASME Aviation Div. Conference at Statler-Hilton, Dallas, Texas.

Bits and Pieces

GE has increased the power output of its Vallecitos Boiling Water Reactor by 50% without any change in design or addition of fuel. At the new output of 30,000 kw of heat it supplies enough steam to generate 6,500 kw of electricity. At 20,000 kw of heat, 4,500 electrical kw were possible. . . . In the new billion dollar, four-year, aid-to-education program, the states will kick in some $500-600,000 in matching funds. But the states don't have to buy the whole program; they can take as much of it as they want. Also, the integration or church-state issue is not forced. . . .

FALLOUT INSURANCE

AEC will indemnify its contractors, subcontractors and suppliers against nuclear accident claims up to $500 million. . . . Nuclear development overseas will provide US manufacturers with a $3.1 billion market over the next ten years, according to survey by Vitro Corp. of America. Power reactors and equipment will run $2 billion. . . . Chrysler Corp. has formed a missile division and will have charge of R&D, engineering and production of Redstone and Jupiter; they will operate a government-owned plant north of Detroit. . . . A run-off election among engineers of Westinghouse's Friendship Airport (Baltimore) Electronic Div. resulted in a rejection of Union representation, 171 to 115. . . .

ANGLO-CANADIAN COAXIAL

Television cable linking Canada and England may be no more than three years away, according to Pye Electronics, English firm. . . . Dow Chemical Co. has contract to build a magnesium hull for a lightweight armored vehicle. If successful, it will weigh less than one-third as much as models now in use. . . . While major objective of Russia's latest 5-year plan, which began in 1956, is to increase means of production by 70% and output of consumer goods by 60%, all types of electrical, mechanical, optical, radiation measuring instruments, related instruments for automation will be increased by 300%.

READER TO EDITOR

Frustrated Scientists

To the Editor:

Your editorial, "Which: How or Why?," (Jan. 6, p. 55) indicates the basic root of the engineering profession's problems—engineers are fundamentally engineers. Why attempt to make an elephant out of a tiger? For some time a consistent attack has been made on engineers by mathematicians, physicists, and humanists. It appears that engineers must be molded to somebody else's image. Since the basis of engineering is to build and organize men and machines, engineering will always be a "how" profession. Why? It is an applied field, and theoretically always in the province of the men of science. It is their desire and inclination to do basic research.

Now is the time for practicing engineers to voice their opinions against the tide of frustrated scientists who cannot make a good showing on their own and who clutter the field with nonsense. The problem is not what's wrong with engineering, but what is wrong with science. Are we truly producing the physicist, the mathematician, and the chemist? Are they prepared to meet the challenge of basic research? Are they prepared to give the engineers the basic tools?

Something must be wrong with the scientific world; so many scientists prefer the cloak of engineering. Why do they leave the basic research field for which much time and energy has been expanded? The attention of education must be centered on the sciences and basic research. Engineers have met their test in design, production and need not apologize to any body. —NAME WITHHELD

Time to Get Out

To the Editor:

I was an Assistant Chief Electrical Engineer on my last job and was laid off because my company lost a contract. I went to the Professional Office of the N. Y. State Unemployment Div. It was like old home week—I never saw so many old friends that were unemployed, some with 30 years' experience.

I notice most of the engineering-shortage surveys are taken by management. They are all wet. Talk to the men and see what they have to say. Go to the Unemployment Office and ask them. Management would like people to think that there is a shortage so more high school students will think engineering is a wide-open field. Then there would be so many engineers on the market, the men who don't have jobs will be willing to work for peanuts.

Any man with vision can see this. I for one am getting out of this field as fast as I can.—RICHARD SHIPLEY
New York, N. Y.

A Shot at PE

To the Editor:

Please gentlemen! Let us keep our minds on our work. In your Jan. 6 issue (p. 37) you speak of BOAC developing a unit, ". . . that transmits pressure changes to a Bourbon tube." A Bourbon might promote hysteresis, which I have been led to believe is a lagging or retardation of effect after the forces acting are changed or withdrawn. I find it hard to agree with you however that such a thing can be used to measure thrust.

—IAN MAC LEOD
Landenberg, Penna.

• Needless to say, our typo should have read Bourdon–Ed.

Increasing Complexities

To the Editor:

Your editorial, "Ugly Little Fact" (Jan. 20, p. 51), pointing to the increasing complexities of the problem-solving processes facing engineers today is very timely. The rate of our material progress, as well as our national security, depends in great measure on the effectiveness with which our engineering and scientific people are able to cope with the ever-increasing accumulation of technical data. The problem of maintaining a healthy climate for meaningful creative activity, therefore, assumes a degree of urgency.

The administrators of our various research and development programs should seek to encourage the creative faculty wherever it may appear. An engineering synthesis achieved by way of an intuitive approach based on sound principles can be as equally valid as one arrived at via the exercise of pure logic. The emphasis on methodology at the expense of what Alfred North Whitehead refers to as the "aesthetic apprehension" of objective reality is limiting and ultimately self-defeating.—SIDNEY FLAX
Boston, Mass.

Quality, Not Quantity

To the Editor:

May I compliment you for your forthright presentation of my letter on the surplus of engineers (Dec. 2, p. 4). Your direct action requires an apology for my inferences of your views being management-colored. The 1939 and 1946 surveys took the average engineer's salary. The 1949-1950 study I referred to in my letter surveyed only SENIOR engineers. A comparison between these two levels of performance for different periods cannot but lead to erroneous conclusions, particularly when no statement of the levels is made. Of course, administrative engineers' salaries would be much higher than an average engineer's.

Our nation's primary problem with its engineering reserve should be with adequate quality, not quantity. The present proposed Federal scholarship plan will attract more students, but students with native high intelligence will take a longer look at the low pay of our Federal Civil Service engineers when they choose their profession.

Let's make engineering financially attractive. —HARRY W. CORDES
Palo Alto, Calif.

One-man Industrial Elevators

To the Editor:

In 1916, I worked in the mills of the Quaker Oats Co., Cedar Rapids, Iowa. They used individual elevators (Nov. 4, p. 60); however, these were not in any shaft but simply used a traveling vertical leather belt on which was fastened a wooden platform about 24 in. wide. About 5 ft above the belt there was a handle riveted under the belt so that the passenger could have a hand hold. —ANSON E. MEANOR
Chicago, Ill.

• Industrial elevators of this type seem to be more common than individual passenger elevators–Ed.

interlining by the Yard...

or mattress by the Mile!

Urethane Foams

prove their versatility

You've never seen a material that can be made in so many forms with varying properties to do so many jobs so well!

By changing chemical formulations, the density, resilience and other characteristics can be controlled. Some urethanes are ideal for comfort cushioning while others absorb impact with a minimum of rebound. Potential uses are particularly numerous in cushioning and packaging.

Urethane foams are excellent, too, for thermal insulation and where light weight and durability are desired. They are low in first cost and economical to fabricate, permitting many short cuts in production.

If you have a potential cushioning or insulating application for urethanes, tell us about it. We will gladly refer you to sources of supply and provide pertinent data based on the most recent work of our Research and Engineering Center.

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National Aniline does not make urethanes but is a major producer of diisocyanates—Nacconates®—basic component of all urethane formulations.

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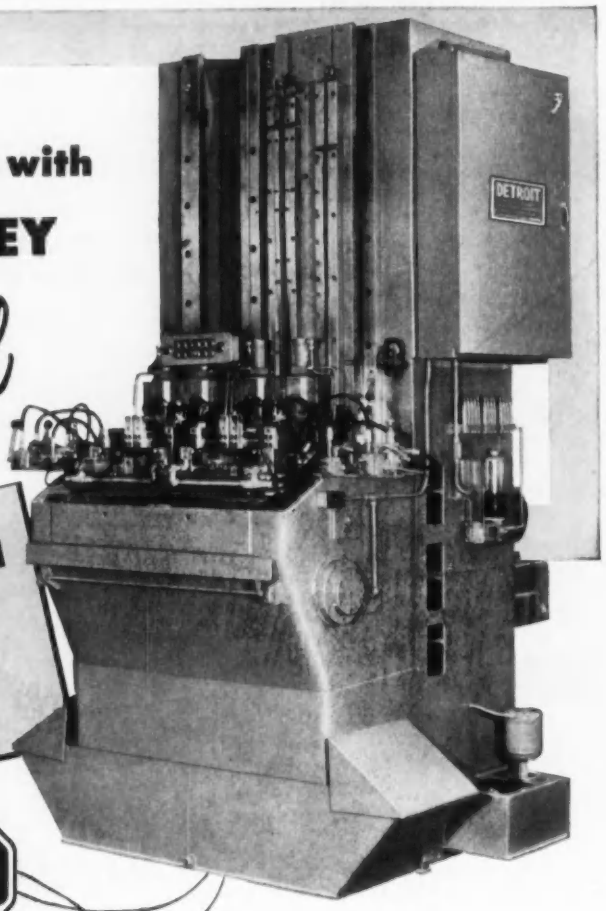
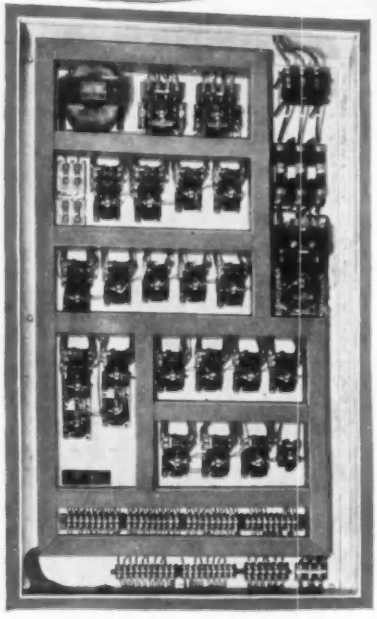
Akron Atlanta Boston Charlotte Chattanooga Chicago Greensboro Los Angeles New Orleans Philadelphia Portland, Ore. Providence San Francisco Toronto

FACTORY EQUIPPED with ALLEN-BRADLEY Motor Control



DETROIT BROACH & MACHINE COMPANY
dual ram vertical

A-B QUALITY



Special control panel for Detroit Broach Dual Ram Vertical. All Allen-Bradley components are standard units listed in the latest A-B Handy Catalog. Please write for your copy, today.

Motor control panels put the "life" into modern production machines . . . starting, stopping, or reversing the various operations at the required time. Because of its *exact* and *reliable* performance, Allen-Bradley quality control is the first choice of leading machine tool manufacturers.

Allen-Bradley solenoid motor starters, relays, and contactors have only *one* moving part—this is your assurance of millions of trouble free operations. There are no bearings or pivots to stick and cause trouble. With friction virtually eliminated, the time to "open" or "close" the circuit is consistent—operations *always* occur exactly on time. Also, all Allen-Bradley controls use double break, silver alloy contacts that never need attention.

Standardize on Allen-Bradley—the *quality* line.

In addition, the quality line of Allen-Bradley motor control is backed by a quality line of components, such as push buttons, limit switches, etc. Therefore, for the control of your electrified machines, specify "Quality" throughout—specify Allen-Bradley.

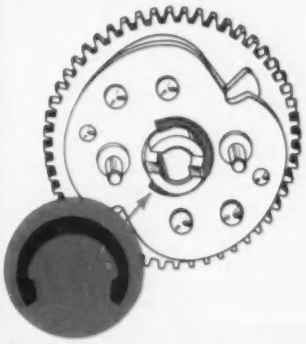
Allen-Bradley Co., 1329 S. First St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

Waldes Truarc Rings speed assembly, facilitate maintenance, improve performance of new automatic calculator

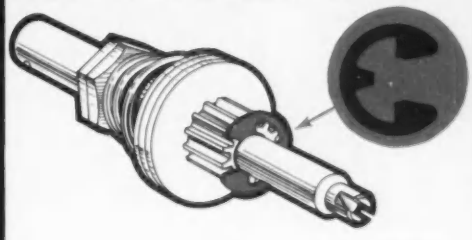
THE NEW MARCHANT DECI•MAGIC

automatic-decimals calculator made by Marchant Calculators, Inc., Oakland, California.

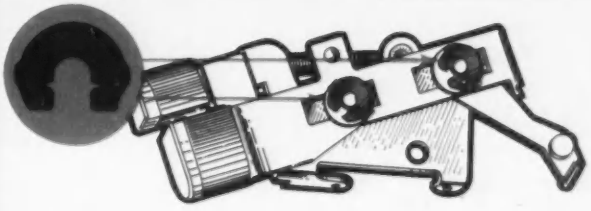


CRESCENT RING SPEEDS ASSEMBLY, DISASSEMBLY

Main clutch utilizes radially-installed series 5103 crescent ring for rapid assembly and disassembly. Ring's low protruding shoulder provides necessary clearance between ring and the two studs. The main clutch operates each time a Deci-Magic control key is depressed.



E-RING SECURES PARTS AGAINST SPRING THRUST. Slip clutch assembly uses Truarc series 5133 E-ring to hold parts on shaft. Functioning of the assembly is dependent upon the ring's ability to withstand thrust exerted by the heavy barrel spring.



LOCKING PRONG RINGS PERMIT SIMPLE DESIGN. Shift slide assembly uses two Truarc series 5139 bowed locking prong rings to lock the parts together in a sliding fit. Precise amount of spring tension prevents objectionable wobble and noise, permits the key to slide smoothly in operation. Easy radial assembly and disassembly of rings facilitates field maintenance and repair. Alternative construction would have required cut washer, spring washer and hairpin-type spring clip on each stud.

Whatever you make, there's a Waldes Truarc Ring designed to save you material, machining and labor costs, and to improve the functioning of your product.

In Truarc, you get

Complete Selection: 36 functionally different types. As many as 97 standard sizes within a ring type. 5 metal specifications and 14 different finishes. All types available quickly from leading OEM distributors in 90 stocking points throughout the U. S. and Canada.

Controlled Quality from engineering and raw materials through to the finished product. Every step in manufacture watched and checked in Waldes' own modern plant.

Field Engineering Service: More than 30 engineering-minded factory representatives and 700 field men are at your call.

Design and Engineering Service not only helps you select the proper type of ring for your purpose, but also helps you use it most efficiently. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

WALDES

TRUARC®

RETAINING RINGS

WALDES KOHINOOR, INC.

47-16 AUSTEL PLACE, L. I. C. 1, N. Y.

Waldes Kohinoor, Inc., 47-16 Austel Place, L.I.C. 1, N.Y.

Please send new, descriptive catalog showing all types of Truarc rings and representative case history applications. *(Please print)*

Name _____

Title _____

Company _____

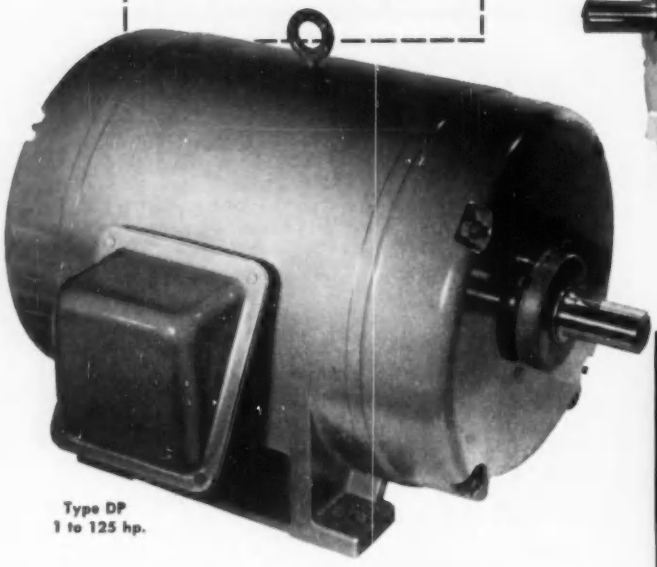
Business Address _____

City _____ *Zone* *State* _____

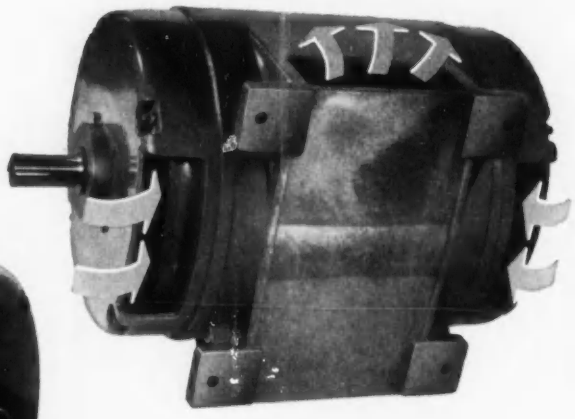
PN8209

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

WAGNER
POLYPHASE
MOTORS



Type DP
1 to 125 hp.



These open type motors give DOUBLE PROTECTION... can be used in many places that formerly required splashproof motors

Wagner Type DP Motors offer the *double protection* of rugged corrosion-resistant cast iron frames and dripproof enclosures so well designed that the DP Motor can handle many applications that formerly required splashproof motors.

These Wagner Motors are built in the new NEMA ratings that pack more power into less space, are lighter in weight and are easier to maintain—only occasional lubrication is required.

SLEEVE BEARING MODELS AVAILABLE

The entire line of ratings through 125 hp. is available with steel-backed, babbitt lined sleeve bearings that have high carrying capacity and provide quieter operation.

Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Wagner Bulletin MU-223.

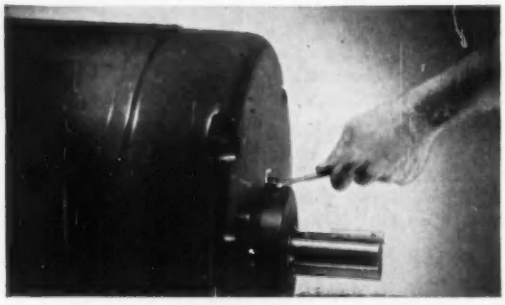
1 to 125 HP—1750 RPM—40°C NEMA FRAMES 182 through 445U

Wagner Electric Corporation
6406 Plymouth Ave., St. Louis 14, Mo., U.S.A.

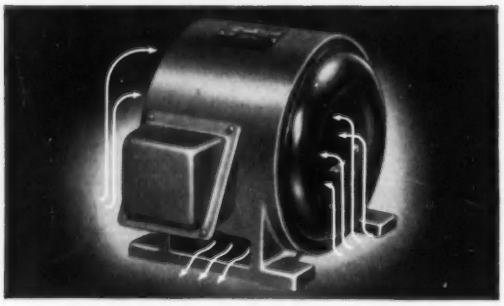
WM58-4

SEE OUR EXHIBIT—DESIGN ENGINEERING SHOW—BOOTH 558

DOUBLY PROTECTED — Wagner DP Motors offer the *double protection* of completely dripproof enclosures and rugged cast iron frames that can take rough handling and resist corrosion.



CAN BE RELUBRICATED — These motors can be re-greased when desired for longer bearing life. Fresh grease can be added—old grease removed—through openings provided in the ball bearing housing.



COOL RUNNING — Specially designed baffles direct cooling air through the motor to protect the stator windings. Blowers, cast as part of the rotor, move large volumes of air without noise or vibration.

announcing

new possibilities with steel tubing!

GM STEEL TUBING WITH ZINC I.D. IS FIRST TO COMBINE HIGH CORROSION RESISTANCE WITH THE STRENGTH AND ECONOMY OF STEEL!

A new and unique product enters the tubing field . . . GM Steel Tubing with Zinc I.D.! Now steel tubing can be used in applications which have been restricted to more expensive material.

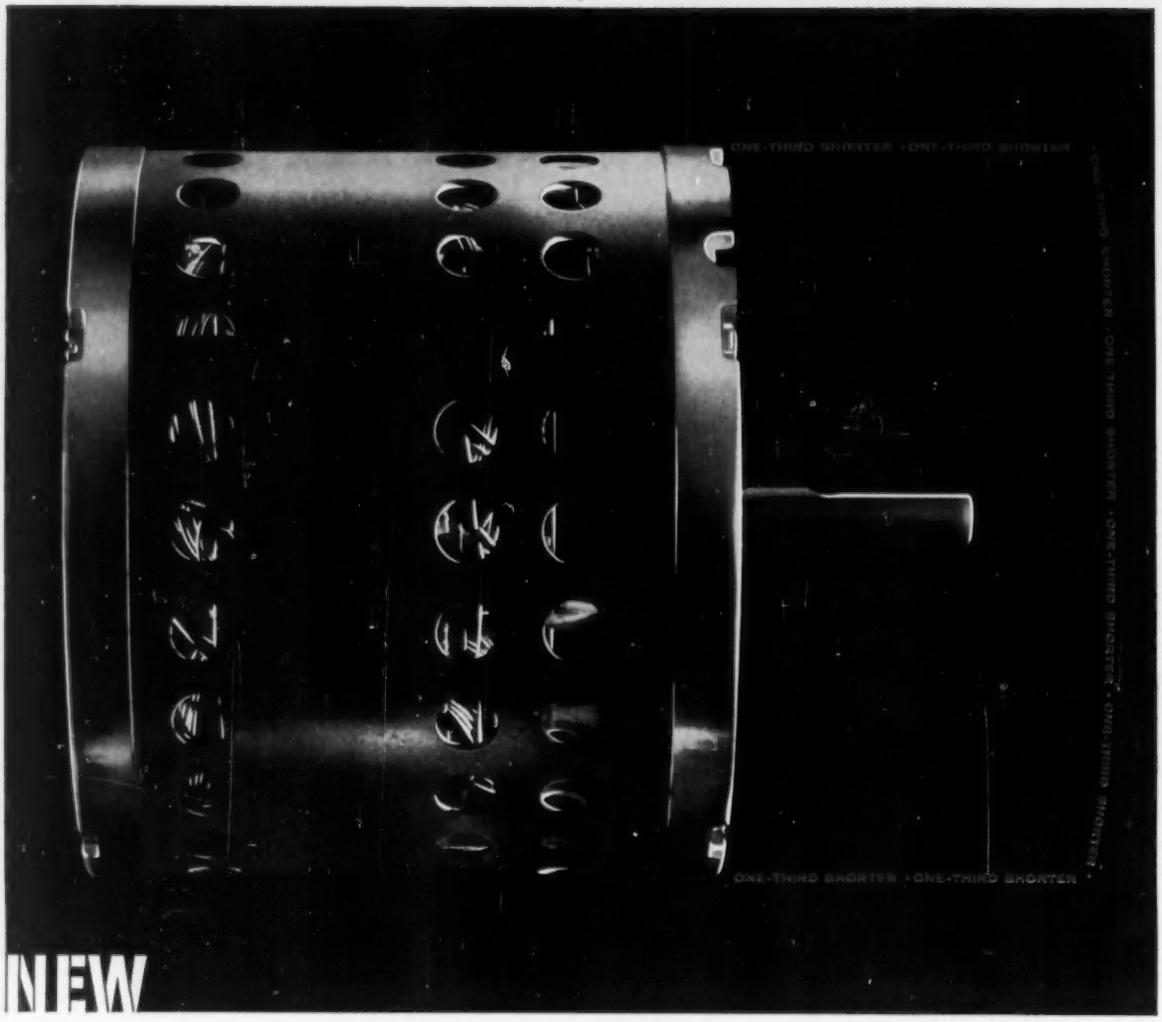
For the first time steel tubing has been given superior corrosion resistance in any length up to bulk coils of 1000′ or more by an inexpensive process that preserves the outstanding economy of steel and permits the use of steel's preferred qualities of strength and ductility in critical applications.

Zinc I.D. has a corrosion resistant metallic coating which is non-porous, uniform in thickness and sufficiently ductile for manufacturing operations. The coating does not yield a volume build-up of corrosion deposits. Furthermore, the tubing is completely annealed and the coating entirely intact when delivered.

This exclusive new product offers substantial savings and opens new possibilities with steel tubing in a host of industries. Write for additional information, or call your GM Steel Tubing Sales Engineer. Learn how GM Steel Tubing with Zinc I.D. can make immediate savings in your operation.

GM STEEL TUBING by ROCHESTER PRODUCTS

ROCHESTER PRODUCTS DIVISION OF GENERAL MOTORS, ROCHESTER, N. Y.



NEW SHORTEST APPLIANCE MOTOR YET!

Delco announces the shortest motor in the appliance industry, at no sacrifice in power or performance.

It's shorter. It's lighter. It can be mounted at any angle. It's Delco's new "C" series motor, and means many new design possibilities in the appliance industry.

Besides being a far more compact unit, it offers the same performance and electrical characteristics as the longer, heavier "A" motor. It's completely interchangeable in breakdown torque, starting torque, starting amps and temperature rise, and can be furnished with interchangeable mountings. More than that, the new motor has even less vibration than its predecessor.

Get all the interesting facts on the "C" series motor from your nearby Delco Products Sales Office. It's an engineering first that means new freedom of design in your product. And remember—like all Delco motors, this new one, too, is backed by the research, know-how and dependability of Delco Products and General Motors.

THE SEVEN WONDERS OF THE NEW "C" SERIES MOTOR —

1. *33% shorter (through bolt mounting)*
2. *19% less weight*
3. *All angle mounting*
4. *Improved ventilation*
5. *Complete interchangeability*
6. *Vibration reduced*
7. *Quieter operation*

GM GENERAL MOTORS

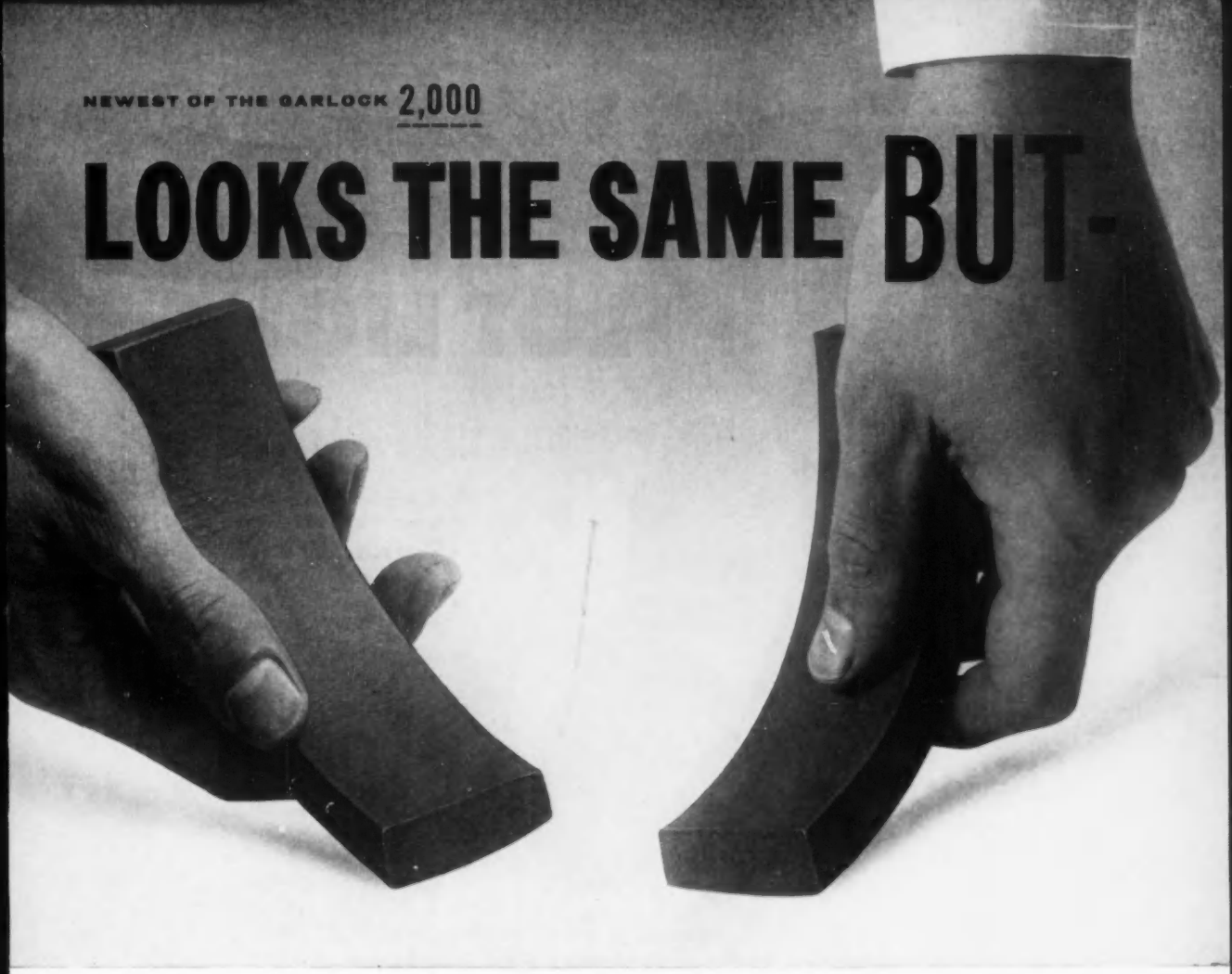
DELCO MOTORS

Delco Products
Division of General Motors, Dayton, Ohio

- APPLIANCE MOTORS • INDUSTRIAL MOTORS
- GENERATORS • ACTUATORS
- AUTOMOTIVE AND HYDRAULIC EQUIPMENT
- HERMETIC MOTORS AND CONTROLS
- RESIDENTIAL GARAGE DOOR OPERATORS
- AIR SUSPENSION COMPONENTS

NEWEST OF THE GARLOCK 2,000

LOOKS THE SAME BUT-



THERE'S A DIFFERENCE!

(One is Garlock's New Sponge Silicone Rubber for temperatures from —100°F to +500°F)

The hand on the right holds Garlock's latest development . . . Sponge Silicone Rubber. The other hand holds "ordinary" sponge rubber. Outwardly, they look the same, the difference is that Sponge Silicone will remain flexible at temperature extremes, sheds water, resists adhesion of ice, resists tearing or abrasion . . . in fact, Garlock Sponge Silicone Rubber is the ideal seal for around airframe openings like doors, ports, bomb bays or hoods.

Millions of non-connecting cells provide Sponge Silicone Rubber with a natural insulation which, together with the base material, make it able to withstand temperatures from —100°F to +500°F . . . and still remain flexible. Moreover, Garlock Sponge Silicone Rubber can be extruded, thick or thin, in a variety of forms with very low compression set. It's available in sheets, round and odd extruded cross sections, or simple extruded cross sections for splicing into endless rings.

New, soft Sponge Silicone is the latest of the "Garlock 2000" . . . two thousand different styles of packings, gaskets, and seals for every need. It's the only complete line. That's why you get unbiased recommendations from your Garlock representative. Call him today!

CROSS SECTION

Cross Section of Garlock Sponge Silicone Rubber shows millions of non-connecting cells which provide natural insulation as well as low temperature flexibility to —100° F. . . . heat resistance to +500° F.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

NEW! "Feather-touch" PUSH-to-TEST PILOT LIGHT

- Completely oil-tight, even when depressed
- Pressure connections eliminate internal wires
- Positive contact "feel" in test position
- No additional panel space required
- Choice of 6 color caps
- Full range of voltage ratings
- Mounts interchangeably with oil-tight pushbuttons and selector switches

Here's Why Square D Pushbuttons are preferred —by those who *build* machines—and by those who *buy* them

Easy to use • Square D oil-tight pushbutton operators require only a single mounting hole. Contact block terminals have pressure wire connectors for simplified wiring.

Longer lasting • Operators have all-metal construction, with anodized aluminum buttons for greater mechanical life. Melamine contact blocks with double-break silver contacts assure longer electrical life.

Wide flexibility • Any operator can be used with any contact block to meet all your requirements. Pushbuttons, selector switches, and pilot lights mount interchangeably.

Small size • Square D oil-tight pushbuttons require only a minimum of panel and back-of-panel space—and they can be mounted in any position.

Variety of contacts • Contact block arrangements include single-pole double-circuit, duplex double-circuit, tandem duplex, three-position duplex, and overlapping contacts.

• • •

FOR COMPLETE INFORMATION

on oil-tight pushbuttons, ask for Bulletin 9001-T —Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin

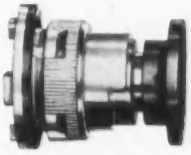
EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

SQUARE D COMPANY

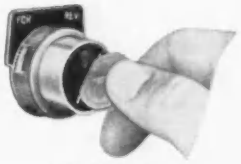
LATEST ADDITION to SQUARE D LINE of Oil-Tight Pushbuttons

OIL-TIGHT OPERATORS

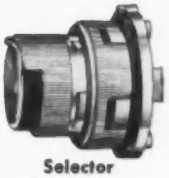
Standard Button


Mushroom Button

Selector Switch


Coin-Operated Selector Switch

Key-Operated Selector Switch


Selector Pushbutton

Stop Button Lockout

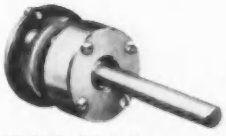
Start Button Lockout

Maintained Contact Attachment

Selector Switch and Pushbutton Lockout

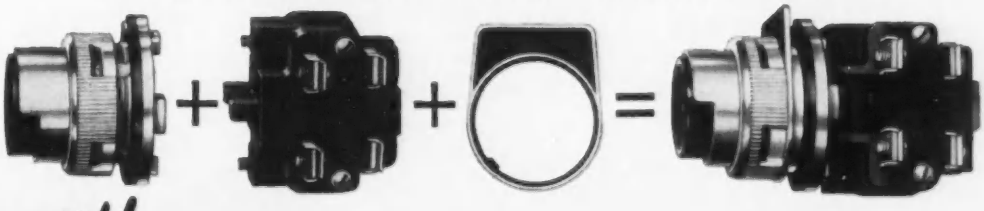
NEW!

4-Position Joystick Operator

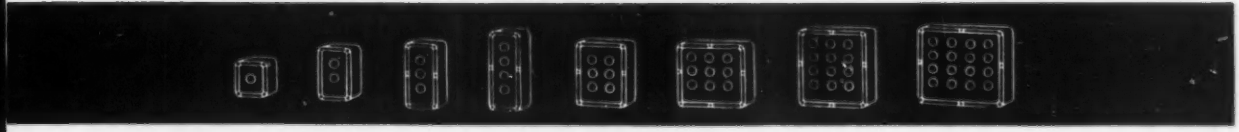

Wobble Stick Operator

Neoprene Cap

ANY OPERATOR WITH ANY CONTACT BLOCK



NEW!—*NEMA 12 Sheet Steel Enclosures Available for 6 to 25 Units*
Cast Enclosures Available for 1 to 16 Units



Seeburg designers choose P-K® screws

to match the fastener to the job!

Joseph Kamys, engineer, J. P. Seeburg Corporation, Chicago, manufacturers of coin operated phonographs says, "Seeburg standards demand attention to every detail—quality workmanship and materials throughout. With Parker-Kalon screws, we can match the fastener to the specific application—be sure of dependable results."

Attachment of metal base molding and kickplate to a Seeburg cabinet, in a metal-to-wood application. "Rather than use ordinary wood screws, we power-drive P-K Self-tapping Type-A," says Mr. Kamys. "Holding power is far better, there's less chance of wood splitting, and fewer rejects at inspection."

Here, metal rims of two high-frequency speakers are fastened to a formed, one-piece, plastic housing. "In this metal-to-plastic application we have not only the problem of possible plastic breakage, but the fastener used must be highly resistant to vibration. We find P-K thread-forming Type-Z screws highly satisfactory."

If you are designing a new product or new model, it will pay you to talk with a Parker-Kalon Field Engineer. He can help in the selection of proper fasteners, can often suggest ways to speed production—cut costs. You can contact him through your local Parker-Kalon Industrial Supply Distributor.

***PARKER-KALON DIVISION,** General American Transportation Corporation, Manufacturers of Self-tapping Screws, Socket Screws, Screwnails, Masonry Nails, Wing Nuts and Thumb Screws.*

Sold Everywhere Through Leading Industrial Distributors. Factory: Clifton, New Jersey—Warehouses: Chicago, Illinois, Los Angeles, Calif.

PARKER-KALON®
fasteners

Design for toughest lubrication requirements!

ALEMITE

REG. U. S. PAT. OFF.

Accumatic®

Centralized Automatic Lubrication

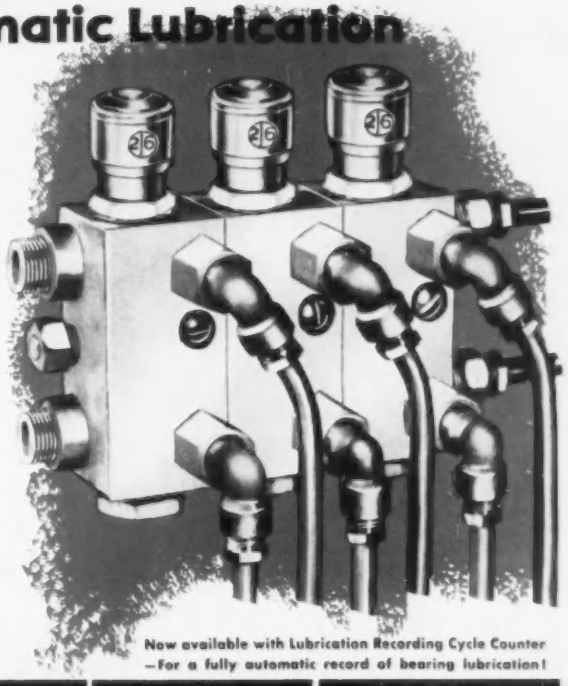
Alemite Type II Accumatic Valves meet big-volume requirements . . . handle difficult multiple-bearing lubrication under all conditions. Fully sealed for *clean* lubrication of power shovels, cement kilns, conveyors—any outdoor or indoor installation. Operate whether completely immersed in fluid . . . covered by dirt or grit . . . or protected by anti-corrosive paint. For fluid oil or light grease. Four sizes, delivering from .050 to .500 cu. in. of lubricant. Fully hydraulic—no springs to adjust or replace.

Factory-Tested—Field-Proved!

Tests show no appreciable variation in the amount of lubricant discharged after 73,312 cycles—equal to *122 years of twice-a-day service!*

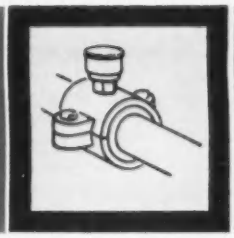
Alemite Accumatic Type II Offers All These Advantages:

- Prevents application of wrong lubricant.
- Seals completely against dirt, grit, water.
- No parts are neglected—lubricates bearings that are inaccessible by hand or dangerously located.
- Eliminates product spoilage due to over-lubrication.
- Eliminates point-by-point lubrication methods—services all bearings in one operation.
- Delivers exact amount of lubricant to bearing.

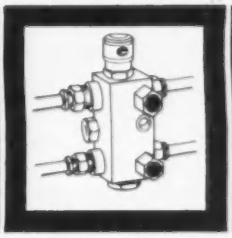


Now available with Lubrication Recording Cycle Counter—For a fully automatic record of bearing lubrication!

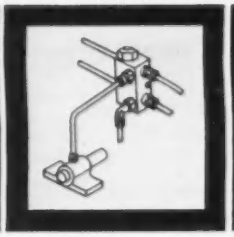
Can be designed into any machine, in 4 EASY STEPS!



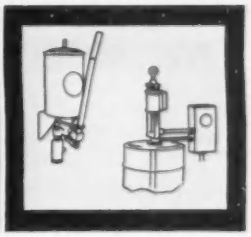
1. Remove grease cups or grease fittings.



2. Connect each valve in system to its two lubricant supply lines.



3. Connect valve outlets to inlet of bearings. (Each valve serves two bearings.)



4. Provide central pump for supplying lubricant to system.

ALEMITE
DIVISION
STEWART-WARNER
CORPORATION

Symbol of **SW** Excellence

1850 Diversey Parkway, Chicago 14, Illinois

ALEMITE, Dept. AA-28
1850 Diversey Parkway,
Chicago 14, Illinois

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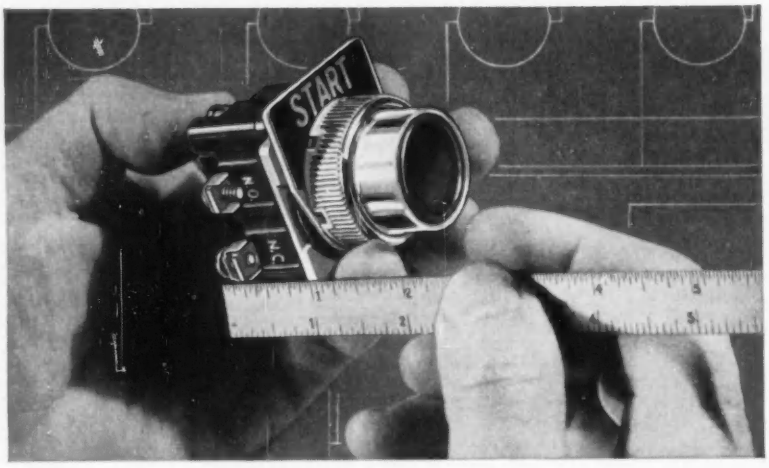
Company_____

City_____ Zone____ State_____

The Panelbuilder

65 YEARS OF SERVICE
CUTLER-HAMMER
MOTOR CONTROL
C-H

News for and about Panelbuilders



Space Saving Heavy Duty Oil-Tight Control Units Provide Greater Circuit Flexibility

To meet the demand for smaller, more flexible heavy duty oil-tight pushbuttons, indicating lights and selector switches, Cutler-Hammer developed the 10250T family of control units. These units, adaptable for either one-hole mounting or base-mounting, offer amazing opportunities for simplified compact control panel design.

Back-of-Panel Depth—1 3/32"

Cutler-Hammer's pushbutton units are available as either flush button, extended button or mushroom head operators. When one-hole-mounted, a double pole pushbutton unit extends only 1 3/32" behind the panel. The double pole contact blocks are available in any combination of normally open and normally closed contact. Each circuit is mechanically and electrically isolated from the other. For additional circuits, contact blocks can be quickly tandem mounted. No special attachments required. Operators come in six distinctive colors.

Indicating Lights Include PresTest

Cutler-Hammer 10250T oil-tight indicating lights, either resistor type or transformer type, have 180 degree non-blinding lenses. These unusually compact lights are available in six brilliant colors, with either unbreakable plastic or heavy glass lens. PresTest, the famous self-testing indicating light, permits instant checking for faulty bulbs without dismantling the unit. Merely by pressing on the PresTest lens, the bulb is disconnected from the normal circuit and checked on a separate test circuit.

Roto-Push—The One-Button Control Station

Cutler-Hammer's Roto-Push is a single unit that combines the functions of the pushbutton and selector switch. Available in either two or three position types, the guard ring rotates to select the desired function while the pushbutton actuates the circuit. Roto-Push offers practically unlimited circuit combinations and often it will replace two or three units. Cutler-Hammer's 10250T family also includes a complete line of two and three position selector switches in a variety of operators.

C-H Master Design

For complete information of Cutler-Hammer's 10250T family of control units write on your company letterhead for C-H Master Design, Pub. EL-178.

NEW HIGHER NEMA RATINGS FOR SIZE 0 AND SIZE 1 STARTERS AND CONTACTORS

NEMA recently approved increased horsepower and ampere ratings for NEMA 0 and NEMA 1 sizes of A-c across-the-line starters and contactors. This is a new industry standard to allow savings in space and cost in the majority of control applications. The following NEMA ratings are now in effect:

NEMA AMPERE RATINGS
A-c Magnetic Contactors

		Old	New
Size 0	open	15 amps	20 amps
	enclosed	13 amps	18 amps
Size 1	open	25 amps	30 amps
	enclosed	22 amps	27 amps

A-c Magnetic Starters

Size 0	open & enclosed	15 amps	18 amps
Size 1	open & enclosed	25 amps	27 amps

NEMA HORSEPOWER RATINGS
A-c Magnetic Contactors & Starters
Single Phase

		Old	New
Size 0	115 volts	1 Hp	1 Hp
	230 volts	1½ Hp	2 Hp
Size 1	115 volts	1½ Hp	2 Hp
	230 volts	3 Hp	3 Hp

Polyphase

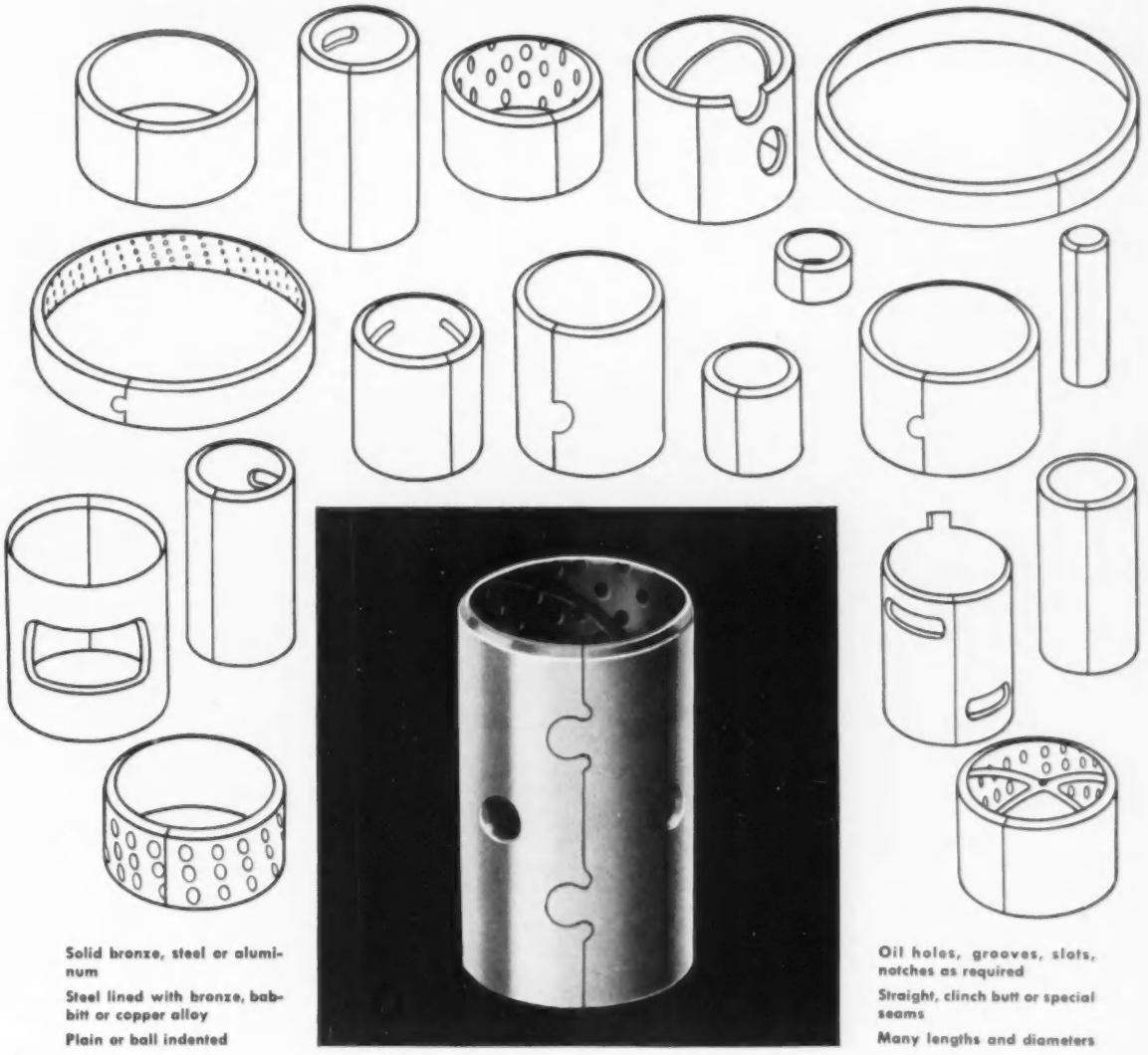
Size 0	110 volts	1½ Hp	2 Hp
	208/220 volts	2 Hp	3 Hp
	380, 440, 550 volts	3 Hp	5 Hp
Size 1	110 volts	3 Hp	3 Hp
	208/220 volts	5 Hp	7½ Hp
	380, 440, 550 volts	7½ Hp	10 Hp

NOTE: NEMA Ratings have not been changed for special duty, plugging, inching, jogging, etc., or for tungsten lamp loads.

All starters and contactors in the Cutler-Hammer line of Three-Star Motor Control have been rerated to these new NEMA standards. Your nearby Authorized Cutler-Hammer Distributor *now* offers them from stock for non-reversing, reversing, and multi-speed requirements. Revised Cutler-Hammer catalog sheets showing all forms of control units with the new NEMA ratings will be supplied on request.

PANEL BUILDERS HANDBOOK SIMPLIFIES SELECTION OF ELECTRICAL COMPONENTS

This handy 70 page reference guide is specifically edited to assist design engineers and control panel builders in the selection of electrical control components and control accessories. Every effort was made to make this book as concise as possible, and yet it includes such vital information as wiring diagrams, dimension drawings, ratings, ordering information and a maintained price list. Address your request for a personal copy on your company letterhead. CUTLER-HAMMER, Inc., 1332 St. Paul Ave., Milwaukee 1, Wisconsin.



Solid bronze, steel or aluminum

Steel lined with bronze, babbitt or copper alloy

Plain or ball indented

Oil holes, grooves, slots, notches as required

Straight, clinch butt or special seams

Many lengths and diameters

Bearing Performance • Bushing Economy plus special design features

Savings in materials, time and labor are possible using bimetal or plain rolled split bushings. Bimetal bushings provide bearing load-carrying qualities. All offer economy through volume production. Uniformity and strength are established through controlled alloy quality and grain structure. Our method of manufacture also permits wide flexibility in design features. Complete engineering service. For details, address:

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FEDERAL-MOGUL DIVISION

FEDERAL-MOGUL-BOWER BEARINGS, INC., 11043 SHOEMAKER, DETROIT 13, MICHIGAN

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HELIARC Welding
breaks the light-gage metal barrier

Welding stainless steel sheet into a smooth, streamlined shape for jet plane fuel tanks is a production job for HELIARC Welding. This method, utilizing a tungsten electrode shielded by LINDE Argon, was developed by LINDE especially for use on hard-to-weld commercial metals.

HELIARC Welding can be used either automatically or manually, in all manual welding positions. LINDE Argon in bulk or in cylinders—99.99% pure—protects the weld. Since no flux is required, joints are clean and smooth, without spatter, saving you time and money.

Get more information about HELIARC Welding. For a free copy of the booklet, "Modern Methods of Joining Metals," write Dept. P-23. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

Fuel tanks for jet planes, made of thin stainless steel, are quickly assembled with smooth, clean and sound seams by HELIARC Welding, a LINDE development.

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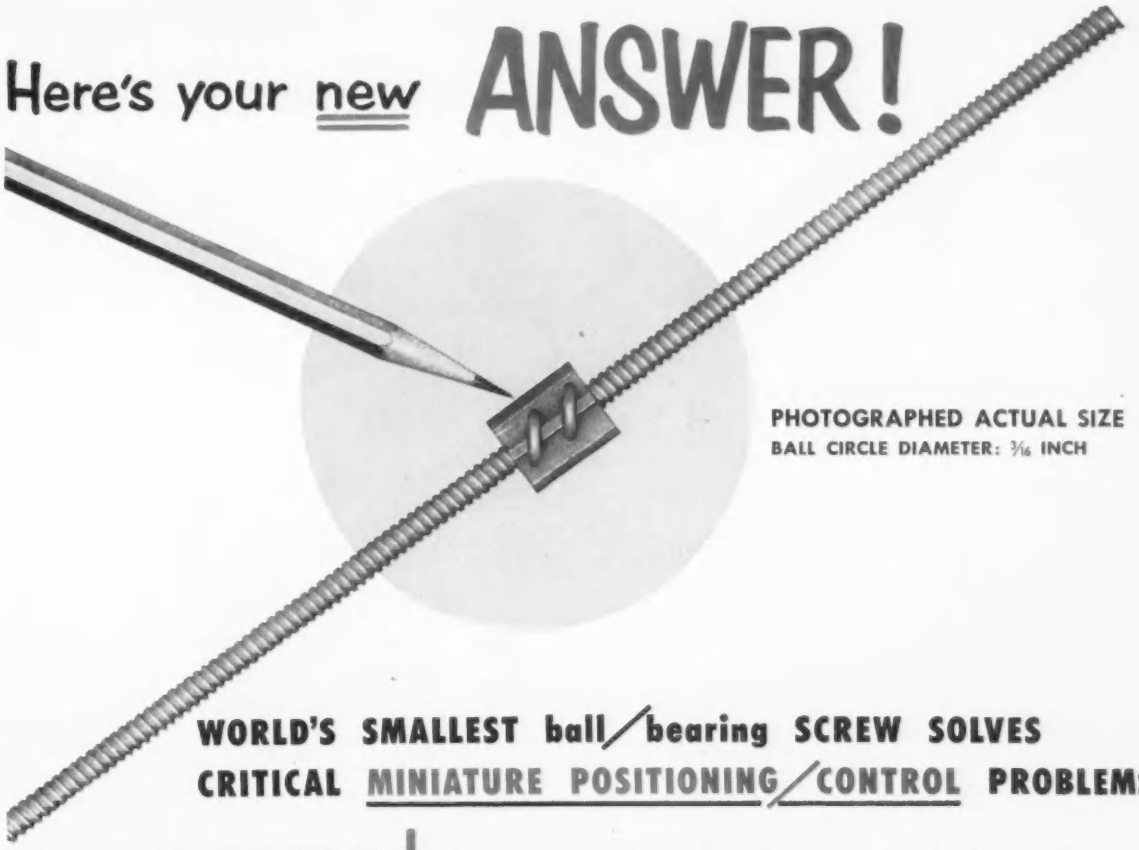
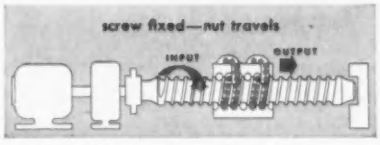
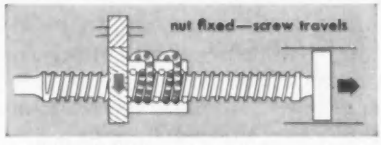


PHOTOGRAPHED ACTUAL SIZE
BALL CIRCLE DIAMETER: 3/16 INCH

WORLD'S SMALLEST ball/bearing SCREW SOLVES CRITICAL MINIATURE POSITIONING/CONTROL PROBLEMS



NUT TRAVELS: When rotary motion is applied to the screw, the b/b nut glides along the axis of the screw on rolling steel balls, converting rotary force and motion to linear force and motion with 4/5 less torque than acme screws.



SCREW TRAVELS: When rotary motion is applied to the b/b nut, the screw glides along its longitudinal axis on rolling steel balls, converting rotary force and motion to linear force and motion with unprecedented efficiency.

An unprecedented achievement in minimum size and weight—maximum efficiency, dependability and service life for ultra-precise controls.

It's another first from Saginaw—and the possibilities it opens up for improved electrical and electronic controls are limited only by your imagination! Radar tuners, missile and rocket guidance and telemetering systems, automatic switchgear, electronic machinery controls are just a few of the applications where this new miniature Saginaw b/b Screw will solve critical positioning/control problems. *It's so compact and light,* you can save substantially on space and weight. *It's so efficient,* (over 90%) you can use much smaller motors and gear boxes. *It's so precise,* you can position components within .0005 inch per inch of travel. *It's so dependable,* you can rely on remarkably long service life even in adverse environments.

You will find our 1958 Engineering Data Book extremely helpful in planning applications, or experienced Saginaw engineers will gladly make specific recommendations without obligation. Just phone, write or mail the handy coupon.

Saginaw

ball/bearing Screw

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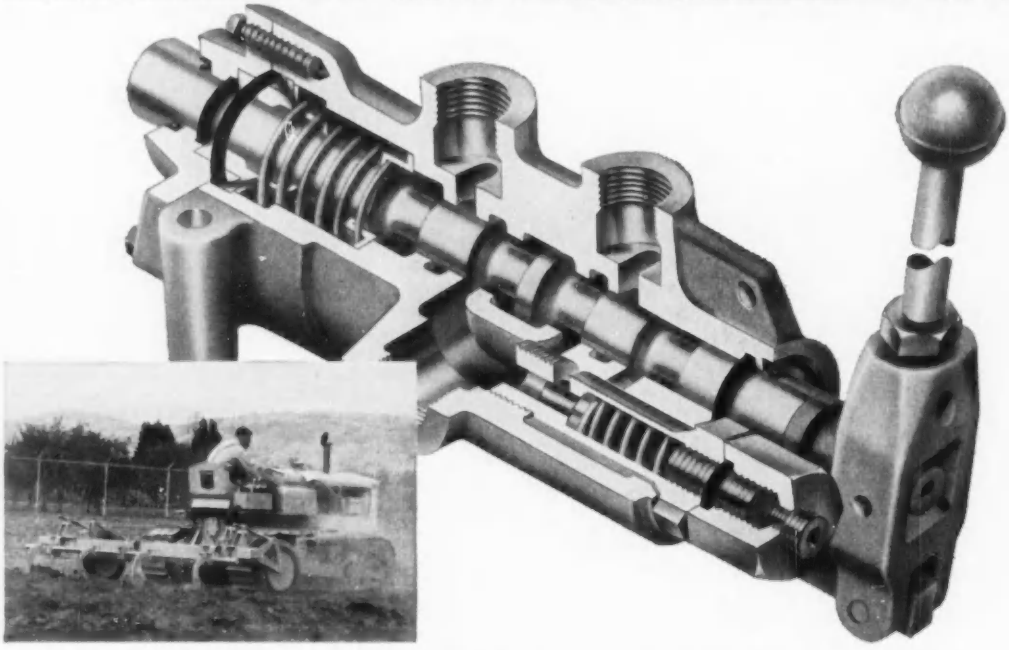
NATIONAL OIL SEAL LOGBOOK



Use of O-rings as moving seal in heavy duty bulldozer control valve

1,500 psi variation without backup rings. Intermittent operation plus long periods of inactivity. Extreme external dust and dirt conditions. Irregular and unpredictable field servicing. Fluid oil temperatures reaching 180°F. Climatic temperature extremes from —30° to +120°F. Life expectancy is required to be that of the tractor.

Above are the rugged operating conditions faced and met by National industrial O-rings in the new Be-Ge Model SU-1200F bulldozer blade control valve. A total of four rings are employed in each unit; two in a moving shaft application and two as static seals.

Be-Ge reports no leakage or ring failure on hundreds of heavy duty applications involving Oliver, Caterpillar, International Harvester and other crawler tractor installations.

National offers a complete line of industrial O-rings, plus many exclusive compounds. Special compounding is also available to meet unusual conditions.

For complete information on National O-Rings, or for skilled O-ring engineering service, call your nearest National Seal engineer. In major cities nationwide. See the Yellow Pages, under "Oil Seals".

Syntech® Oil Seals

Syntech oil seals, developed by and offered exclusively by National, are widely used synthetic rubber seals for applications where temperatures reach 250°F, speeds reach 3,600 FPM, and total indicator runout is as high as .030. Basic 50,000 series Syntech (illustrated) employs a tough, accurately manufactured steel outer case, precision-tensioned spring and accurately molded and trimmed Syntech sealing lip.

Micro-Torc Oil Seals

Micro-torc oil seals, pioneered by National, are sturdy, dependable leather seals. Special elastomer coating on *surface* of chrome re-tanned leather sealing lip prevents seepage of oil. Yet inner body of sealing lip retains natural porosity to "store" lubricant against accidental periods of starvation. Inherent lubricity of elastomer coating produces a lower torque, longer lasting, economical oil seal. Available in a wide variety of types and sizes.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
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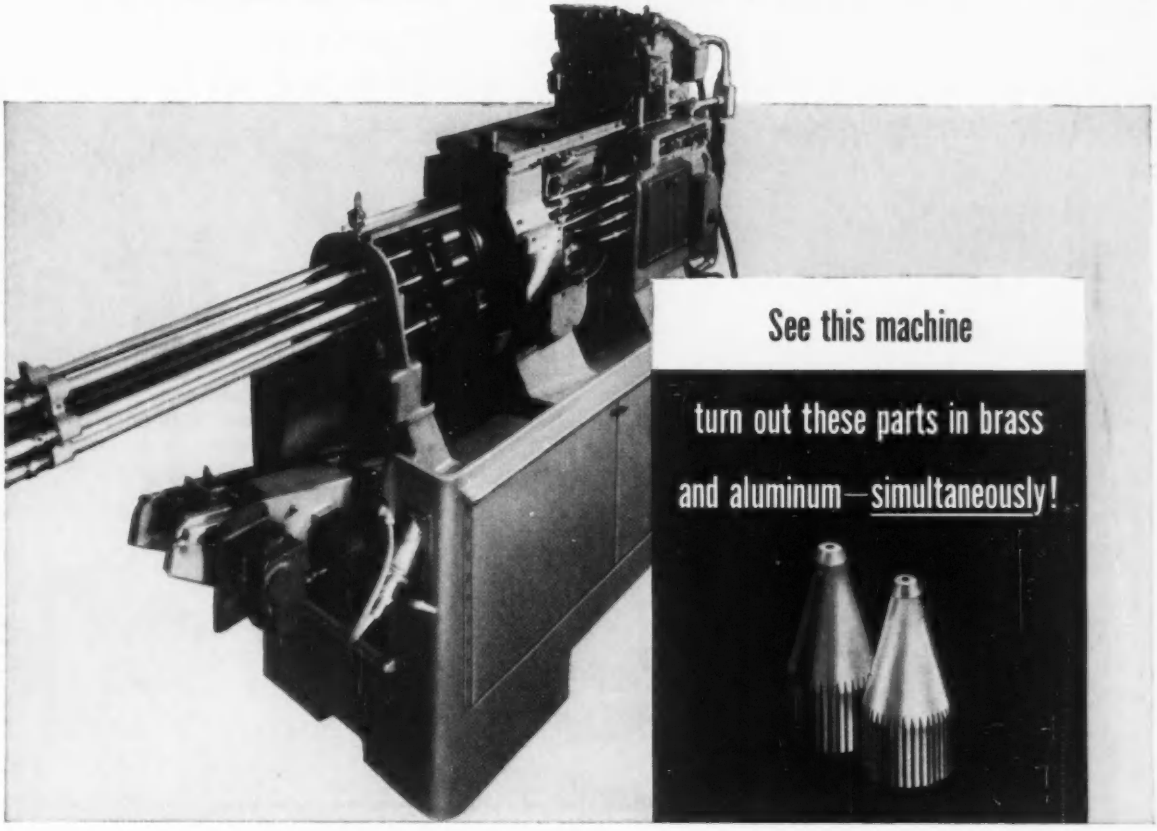
4624

BETTER MACHINING STARTS WITH ALCOA SCREW MACHINE STOCK

Alcoa proved it in Cleveland . . . now will prove it in other cities



See screw machine parts produced in aluminum at less cost than steel or brass

When Alcoa and National Acme Company sponsored a machining demonstration in Cleveland last September, 700 design and production engineers and purchasing people saw aluminum and brass parts produced *simultaneously* on a six-spindle automatic screw machine—saw documented evidence that screw machine parts can be produced cheaper in aluminum than in brass or steel. Many expressed frank amazement at the cost comparisons shown.

Here is eye-opening machining news for all industry. Now *you* can see this demonstration, which Alcoa will sponsor in Chicago, Boston,* New York, Detroit, Los Angeles and other important centers.

If your function is design or production of products that use screw machine parts, you will find the Alcoa machining demonstration an enlightening experience. You will see how aluminum offers the ultimate in design freedom because it's so workable, so easy to machine—because it gives better finishes including anodized color. You will see the new color movie about Alcoa Screw Machine Stock, "The Four Amazing Alloys."

Send in the coupon for your invitation—and for a Design Calculator (slip-stick) for use with Alcoa® Aluminum Screw Machine Stock.

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Aluminum Company of America
865-B Alcoa Building, Pittsburgh 19, Pennsylvania

Yes, I want to attend the Alcoa machining demonstration nearest my area_____.

Please send my invitation—and Design Calculator.

Name_____

Position_____

Company_____

Address_____

City_____ Zone_____ State_____

FAST, HAMMER-DRIVEN RIVET ECONOMICAL FOR BLIND AND OPEN APPLICATIONS

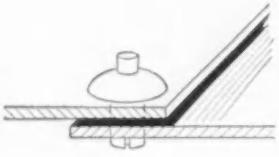


Fig. 1 Inserted in hole, Southco Rivets are quickly set by driving pin with hammer. No special tools are required. Bucking is not necessary.

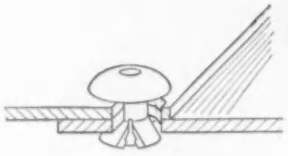


Fig. 2 Expanded prongs force sheets or parts together, hold them tightly in compression. No metal is removed, no grinding or finishing is required.

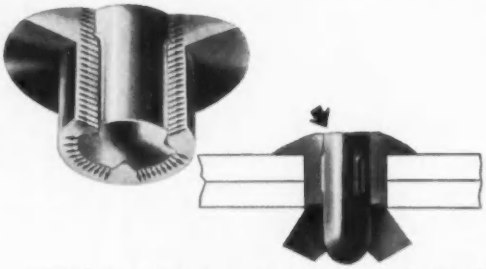


Fig. 3 Pin is locked securely into rivet by displaced metal filling unique grooves. Compression forces are utilized for greater strength.

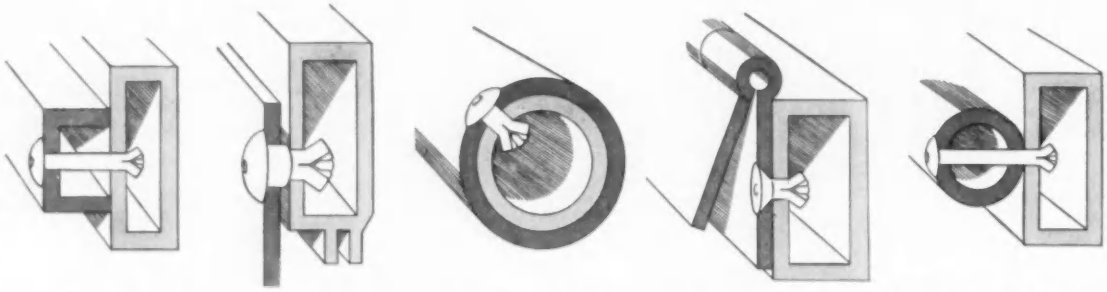


Fig. 4 Ideally suited for "blind" applications, Southco Rivets are worked by one man from one side only and require minimum space inside closed area. They eliminate costly bucking arrangement or time-consuming finishing. Supplied as a unit, they require no job time for assembly or fitting.

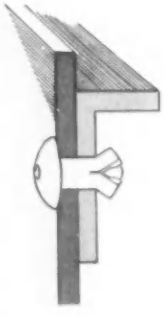


Fig. 5 Access or open fastening utilizes the simplicity, speed and vibration-resistance of Southco Rivets.

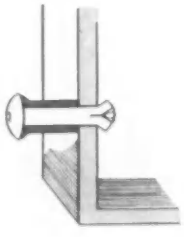


Fig. 6 Ferrules are used as spacers for numerous applications. Here the Southco Rivet forms a drawer pull in conjunction with a flanged tube.

Fig. 7 Increased head size distributes holding pressure over larger area, permits higher loading on wood, plastics and similar materials.

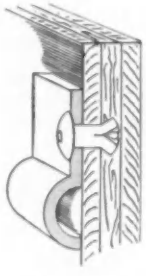
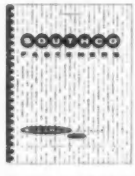


Fig. 8 A blind head can be formed inside the wood. This application is particularly useful when it is desirable to have one surface of the wood unmarred.

FREE!
Fastener Handbook



Send for your free copy of Handbook No. 7. Complete data for designers on these and many other specialty fasteners. 52 pp., two colors.

Write on your letterhead to Southco Division, South Chester Corporation, 236 Industrial Highway, Lester, Pennsylvania.

SOUTHCO FASTENERS
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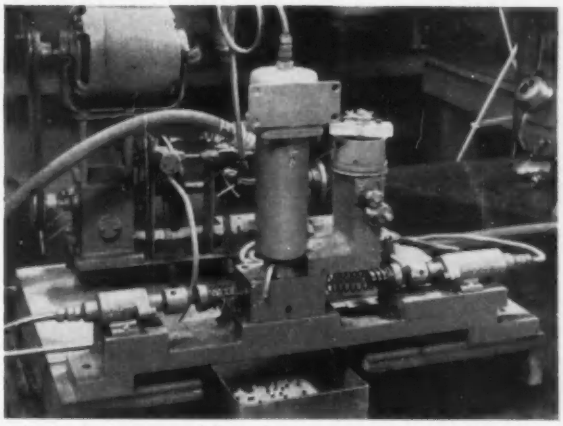
LION

***Progress** in designing air systems:*

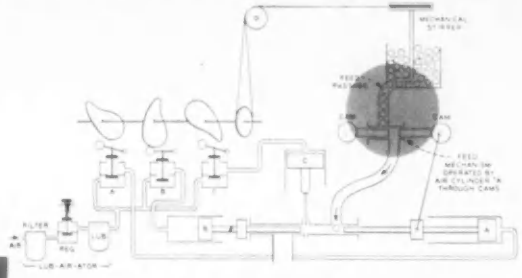
Here's another automating idea: Schrader Air Products in a multi-step punching system

PROBLEM: To pierce tiny balls of lead shot, fast, accurately, and economically.

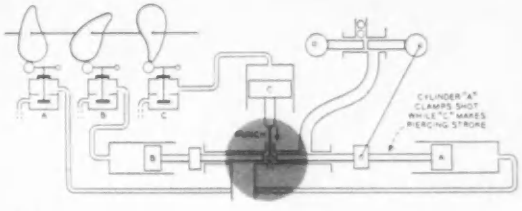


Schrader Products successfully performing at prominent Western plant—feeding, shot-piercing, ejecting—all automatically with air.

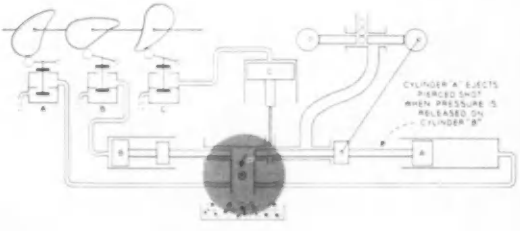
SOLUTION: Schrader Air Products designed into a system for automatic operation.



1 **FEED:** Performance of the cylinders in this system is controlled by cam-actuated Schrader valves. Cylinder A controls split-cam feed; allows the shot to be fed into the machine one at a time.



2 **PIERCE:** The shot is pushed forward and clamped at the piercing station by cylinder A and cylinder B. Cylinder C pierces the shot.



3 **EJECT:** Cylinder B returns to its initial position. Cylinder A completes its forward stroke, ejecting the pierced shot. And cycle starts again.

Air's benefits apply in almost any operation you can name: stamping, forming, programming, squeezing or measuring. And the advantages are more important today than ever: speed, accuracy, safety, simplicity, versatility, and—amazing economy. Schrader components are a natural for the designer because they comprise the only complete line of air products to select from. They can be used singly or in combination to perform jobs of amazing variety and complexity. When you design, think of air, and make use of Schrader's engineering facilities to help you specify the right products for your idea. Mail the coupon today.

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Please send latest informative booklets which show Schrader's complete line of Air Control Products.

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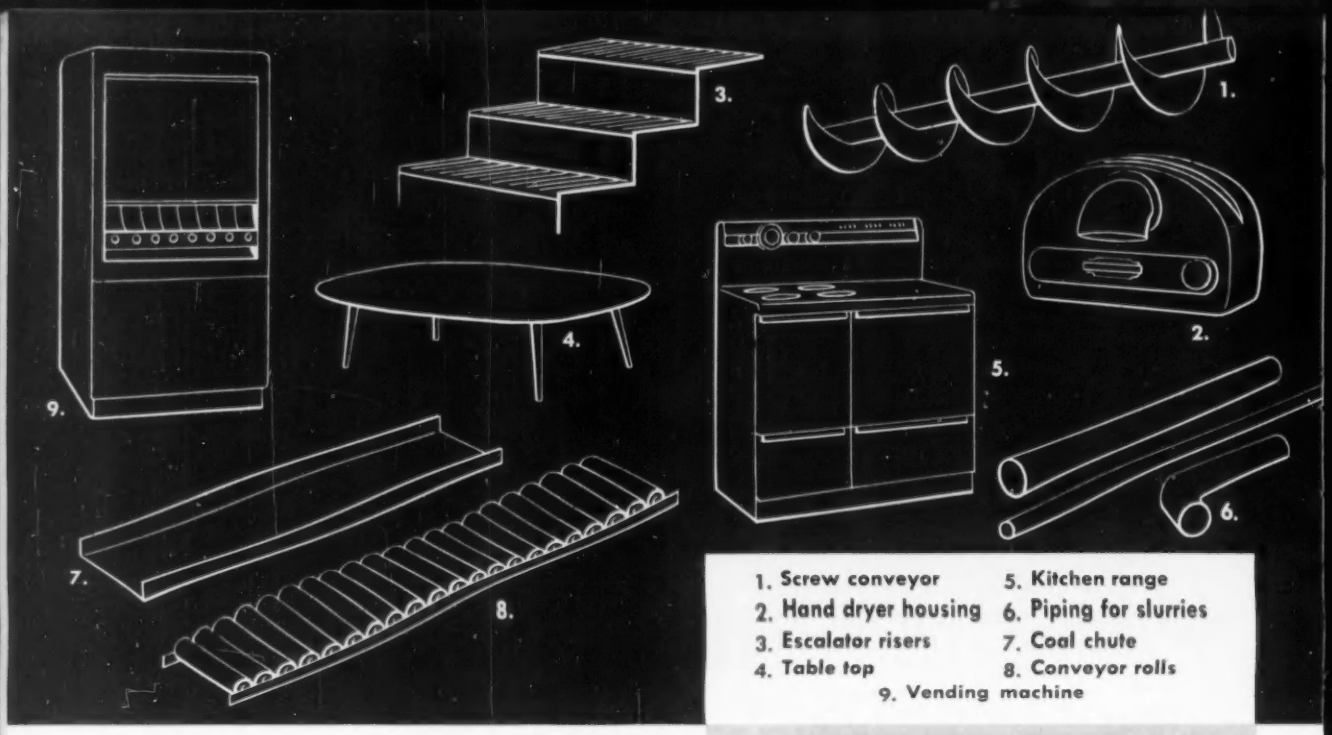


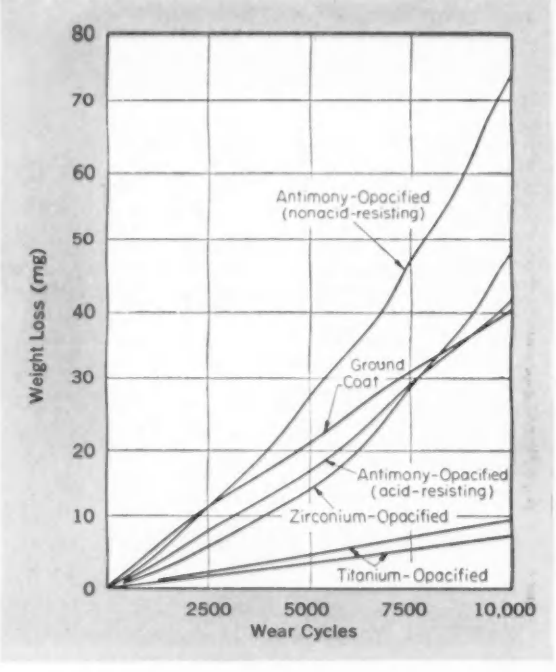
1. Screw conveyor
2. Hand dryer housing
3. Escalator risers
4. Table top
5. Kitchen range
6. Piping for slurries
7. Coal chute
8. Conveyor rolls
9. Vending machine

How PORCELAIN ENAMEL'S HARDNESS improves product performance

Designers increasingly use the extreme hardness of Porcelain Enamel to extend product service in a broad range of applications involving abrasion and wear.

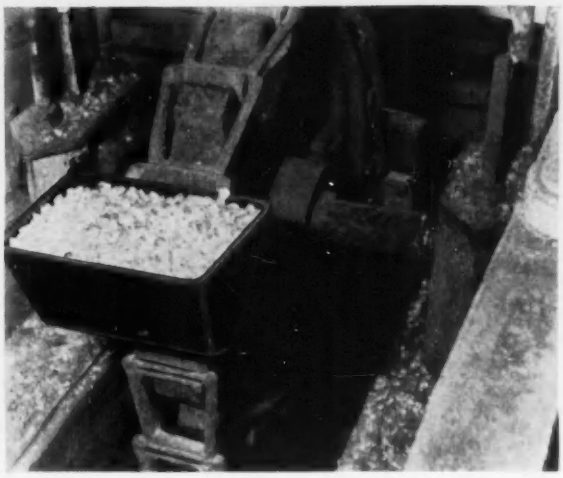
This is one of the hardest known finishes for resisting abrasion. Its hardness ranges from 3½ to 6 on Moh's scale, compared to 2 to 3 for organic finishes. Knoop hardness numbers extend from about 149 to 560, while Sward rocker hardness is 100, the same as plate glass.

Porcelain Enamel is composed of a strong metal product to which is fused permanently a hard, durable, glass-like surface coating. This provides many of the useful properties of glass, with the strength and rigidity properties of metal. Significant related factors are: low coefficient of friction, high strength-weight ratio and low cost.



Abrasion resistance of various enamels as evaluated on a Taber Abraser, using silicon carbide wheel.

While all Porcelain Enamels are relatively hard, some are harder and more abrasion resistant than others. Enamels of this type are hard to scratch with a knife blade. Extremely abrasive-resistant Porcelain Enamels, harder and denser than ordinary types, are available when this property is of prime importance.



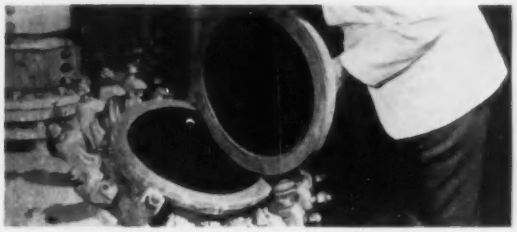
Porcelain Enamel's *Abrasion Resistance*

The material's splendid resistance to abrasion and wear results from high surface hardness, resistance to gouging or crushing and desirable friction coefficient.

These characteristics insure great durability in severely abrasive conditions, even when corrosion is a factor as well. For example, Porcelain Enameled conveyor buckets illustrated above are used in processing rock salt—typifying an extreme condition of both abrasion and corrosion.

In applications such as coal chutes Porcelain Enamel frequently outlasts carbon steel by as much as seven to ten times. Chutes made of Porcelain Enamel are used for handling coke, sand, gravel, ashes and concrete.

Among other abrasion and wear-resistant applications where Porcelain Enamel excels are: conveyor flight plates, grain spouts, work surfaces, conveyor housings, conveyor screws, wood chipper plates, water lubricated bearings, pump cylinders.



Porcelain Enamel's *"Slipperiness"*

High gloss coupled with hardness and low coefficient of friction makes Porcelain Enamel excellent in material handling applications such as package chutes; bunker and silo discharge chutes; kettles, strainer baskets and stripping column plates for processing latex; as bubble caps for tar products; and in food and feed processing equipment.

Porcelain Enamel's *Resistance to Dust and Fumes*

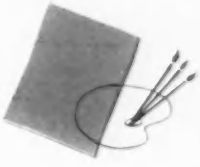
Architectural panels and trim for use in salt air and other corrosive atmospheres, gasoline pump crowns and awnings, chimney caps—these are among representative Porcelain Enameled products which combat the effects of wind-blown dust and corrosive fumes. Many outdoor signs made a half century ago of Porcelain Enamel still retain their glossy finish and original colors.

Designers use **PORCELAIN ENAMEL** *for these additional properties*

Thermal Properties

Corrosion Resistance

Electrical Properties



Color and Texture

PORCELAIN ENAMEL INSTITUTE
Associations Building
1145 Nineteenth Street, N.W.
Washington 6, D.C.

Please send the following:

- ☐ Porcelain Enamel Design Manual
- ☐ List of companies engaged in Industrial and General Porcelain Enameling
- ☐ Design information about possible application of Porcelain Enamel to _____ (type of product)

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

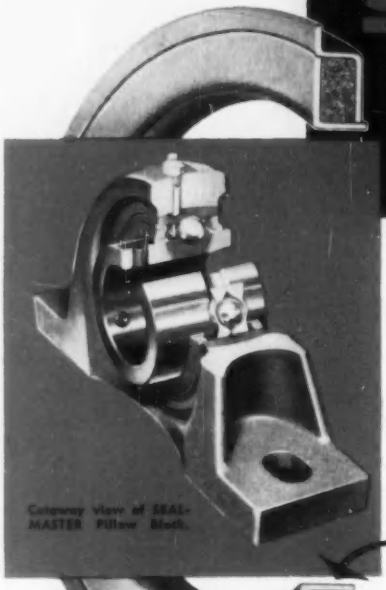
CITY _____ STATE _____

(Please Print)

SEALMASTER'S *Patented*

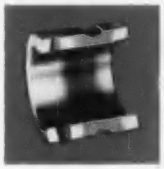
LABYRINTH SEAL

PREVENTS ENTRY OF DUST AND DIRT AND RETAINS PROPER AMOUNT OF LUBRICANT FOR LONG BEARING LIFE!



Ability of SEALMASTER Ball Bearing Units to perform smoothly amid conditions of dust, dirt and grime, is largely due to the design of the Sealmaster patented Labyrinth Seal. Consisting of felt-lined steel flingers rotating in labyrinth, the SEALMASTER Seal prevents entry of dirt and dust into the bearing unit and retains the lubricant within the ball path area. A feature you will want in the bearing units you specify. Remember — there is only one SEALMASTER Seal — most copied because it's most effective.

PLUS THIS EXCLUSIVE COMBINATION OF FEATURES!



ZONE HARDENING . . . assures positive race to shaft holding power. Reduces corrosion.

LAND RIDDEN BALL RETAINER . . . minimizes ball wear, traps grease and prevents "churning."

LOCKING PIN & PERIMETER DIMPLE . . . prevents rotation of outer race, assures positive lubrication.

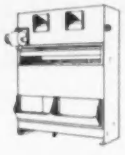
KEEP 'EM ROLLING WITH SMOOTH PERFORMANCE AT EVERY TURN!

MACHINE TOOLS
SEALMASTER quality pays off where the trend is to continuous, fast, automatic equipment.

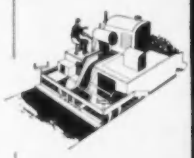
TEXTILE INDUSTRY
Clean, fast production is assured with SEALMASTER Bearings.

FARM MACHINERY
SEALMASTER Ball Bearing Units keep dust and dirt out, lubricant in—a feature Farm Machinery demands.

CONVEYORS
SEALMASTER Ball Bearing Units are featured by manufacturers of many types of conveyors.



AIR CONDITIONING
Quiet, trouble-free performance is assured with SEALMASTER. Find out about new rubber mounted units.



CONSTRUCTION MACHINERY
SEALMASTER Ball Bearing Units provide the features for gruelling performance in construction and materials handling equipment.

SEALMASTER®
BALL BEARING UNITS

Write for Bulletin 454

SEALMASTER BEARINGS A DIVISION OF STEPHENS-ADAMSON MFG. CO. 9 RIDGEWAY AVENUE, AURORA, ILL.

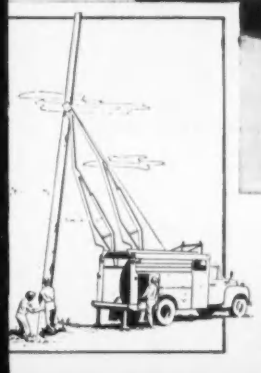
SHELBY SEAMLESS TUBING
helps "Pole-Master"* handle poles like matchsticks

THE POWERFUL, two-legged boom of this "Pole-Master" Hydraulic Derrick is made of cold drawn tubes of USS Shelby Seamless Mechanical Tubing. Capable of handling poles up to 75 feet in length with relative ease, the boom is activated by two hydraulic cylinders, also of Shelby Seamless, which are powered by a heavy-duty hydraulic pump. The derrick has an operating arc of more than 180 degrees, and is designed to "set" poles or "pull" them from the ground. The "Pole-Master" can be used under the most severe work conditions in any weather or climate.

Here is an application in which Shelby Seamless Tubing really excels, for it brings into play all the desirable qualities that Shelby Seamless possesses—high strength, uniformity, shock absorbency, dimensional accuracy, lightness and workability.

Produced to exacting standards by the world's largest manufacturer of tubular steel products, Shelby Seamless is available in a wide range of diameters, wall thicknesses, various shapes and steel analyses. You are invited to call on our engineers for assistance. They will be happy to submit recommendations based on a study of your particular requirements.

**Manufacturer's name on request.*

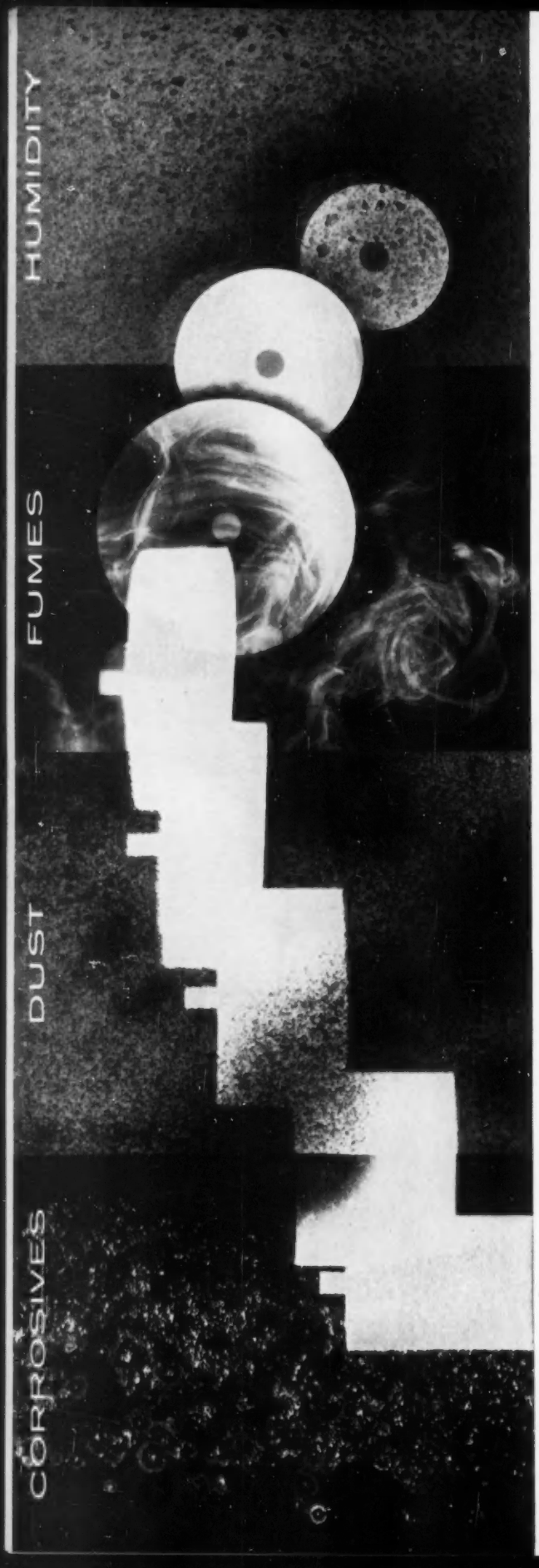


NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS **SHELBY SEAMLESS MECHANICAL TUBING**
A PRODUCT OF NATIONAL TUBE

UNITED STATES STEEL



Need a motor impervious to destructive environment?

Call Jack & Heintz—America's leading specialist in *Customized* motors, 1/8 to 3 hp, (1/3 to 15 hp in submersible motors). We'll gladly devote as much time as it takes to design a motor that's *impervious* to humidity, dust, fumes, corrosive liquids or altitude. We'll give you a motor that electrically, mechanically and physically fits your product and its environment perfectly.

Customizing electric motors to meet the specific requirements of original equipment manufacturers is *our business*. Because we're organized that way, costs are reasonable.

In addition to customizing for environment, we can increase torque, stretch a motor tall, squat it flat, or design-in special ambient temperature rating. We'll make a motor cool, flush, submersible, or give it a special finish. *You name it!*

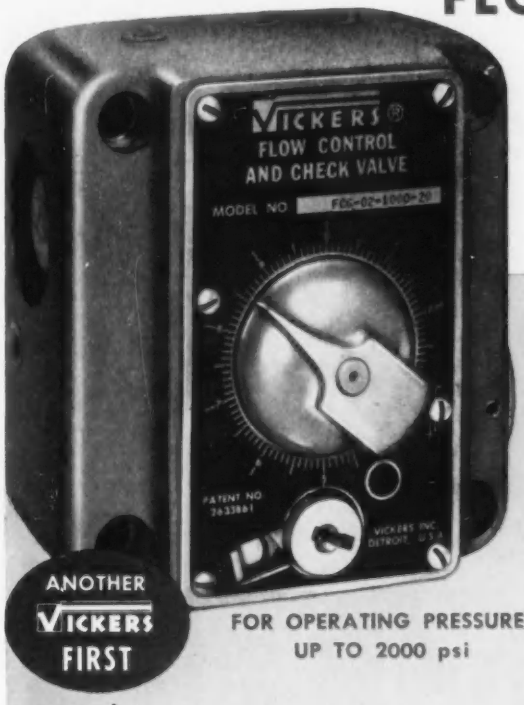
So go ahead freely! Design your product to do its job. We'll fit a motor to it that will make your product perform the way you want it to . . . look as good as it should . . . last as long as you say it will . . . and sell faster because of it.

FREE! Write for this 24-page booklet. It explains when to specify *Customized* motors, shows examples of design variations, illustrates case histories of *Customized* motors for actual products. Write: Jack & Heintz, Inc., 17627 Broadway, Cleveland 1, Ohio.

JACK & HEINTZ, Inc.
CUSTOMIZED ELECTRIC MOTORS

ANNOUNCING!

VICKERS® New ¼" Temperature and Pressure Compensated FLOW CONTROL VALVE



ANOTHER VICKERS FIRST

FOR OPERATING PRESSURES UP TO 2000 psi

For years the Machine Tool Industry has been asking for a combination Temperature and Pressure Compensated Flow Control Valve to insure CONSTANT FEED RATES. Now for the first time it is available as a production unit at a reasonable price.

Check THESE EXCLUSIVE FEATURES that mean Optimum Tool Life and Better Work Finish:

☑ **TEMPERATURE COMPENSATED**
Constant feed rates all day long with same throttle setting because throttle automatically compensates for changes in oil temperature. The compensator mechanism is simple in design and durable.

☑ **PRESSURE COMPENSATED**
Constant feed rate throughout entire cycle because built-in pressure hydrostat automatically compensates for load changes.

☑ **SINGLE THROTTLE COMPLETE RANGE ADJUSTMENT**
Greater flexibility because valve is adjustable within entire flow range of 5 to 1000 cubic inches per minute.

☑ **REVERSE FREE FLOW AS STANDARD FEATURE**
A standard feature which permits reverse free flow (up to 1400 cu. in. per min.) from outlet to inlet port by-passing control elements.

☑ **TAMPER-PROOF ADJUSTMENT**
Retension of original feed rate is assured because a set screw prevents inadvertent throttle movement and a cover over the set screw can be locked in place.

☑ **INTERCHANGEABLE**
This new valve replaces 12 previous models and it is interchangeable with all of them, also the drain connection is eliminated on the new valve to simplify piping.

☑ **GREATER ECONOMY**
No need to stock several valves for wide range of flow rates. Drain connection is eliminated, piping costs are reduced.

☑ **MAXIMUM RELIABILITY AND ACCURACY**
Design of temperature and pressure control components assures maximum circuit reliability and extreme accuracy of feed through a range of 5 to 1000 cubic inches per minute.

FOR ADDITIONAL INFORMATION SEND FOR I-195040 7945

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1454 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO • CINCINNATI CLEVELAND • DETROIT • GRAND RAPIDS • HOUSTON • LOS ANGELES AREA (El Segundo) • MINNEAPOLIS • NEW YORK AREA (Springfield, N.J.) PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) PORTLAND, ORE. • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS • TULSA • WORCESTER
FACTORIES ALSO IN AUSTRALIA, ENGLAND AND GERMANY
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto and Montreal

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

now available
MAMMOTH EXTRUSIONS

Big magnesium and aluminum extrusions produced from Dow's 13,200 ton press

A whole new range of king-size dimensions is now available for design engineers. Dow's new 13,200 ton extrusion press at Madison, Illinois, is producing "special" sizes for quick delivery. These projects include work for aircraft and missiles, automotive, building, and highway construction.

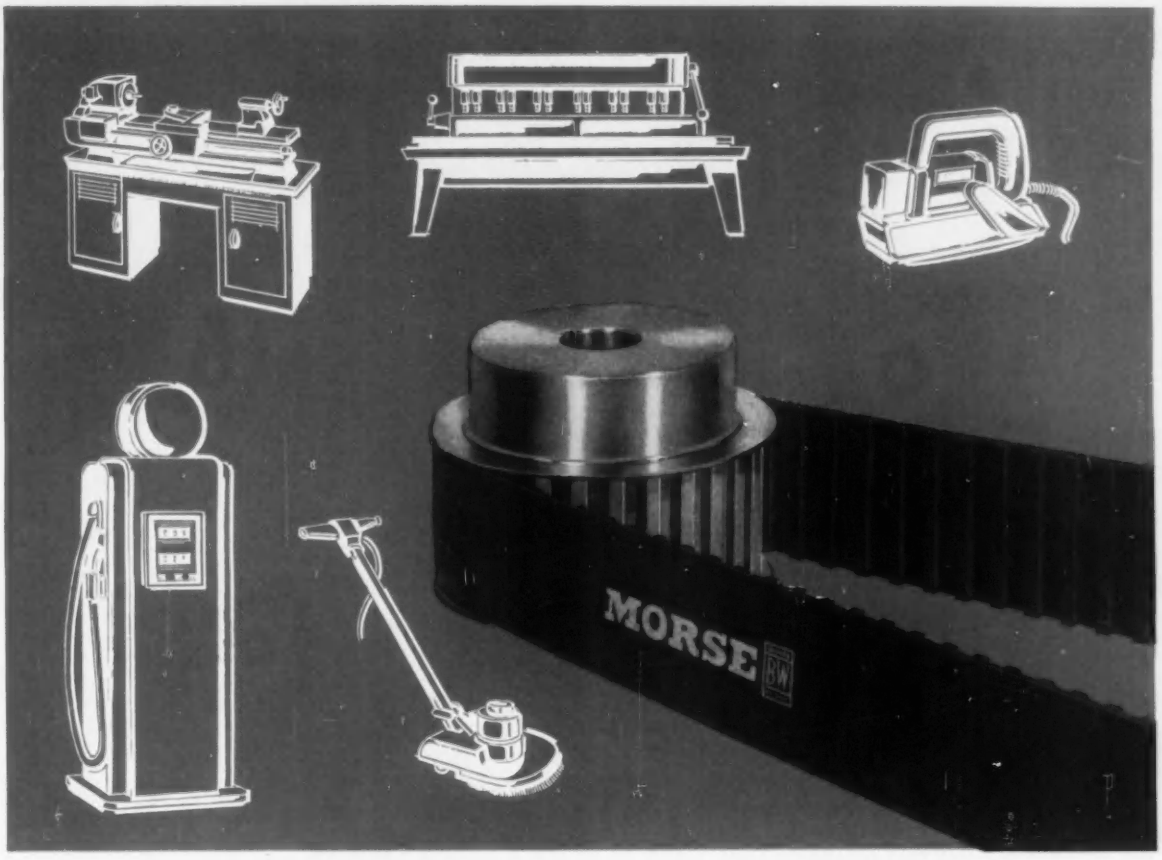
Here's what the big press can do in the way of magnesium and aluminum extrusions to meet your special requirements.

Check this list:

1. **LARGER EXTRUSIONS. Sizes up to a circumscribing circle of 30"**
2. **LONGER EXTRUSIONS. Up to 80 feet in length**
3. **THINNER SECTIONS. Down to 0.125"**
4. **STEPPED EXTRUSIONS. Solid or hollow**
5. **COMBINED HOLLOW EXTRUSION-FORGINGS**

***FOR DESCRIPTIVE LITERATURE** on the big press, contact your nearest Dow sales office, or write The Dow Chemical Company, Midland, Michigan, Dept. MA 1401RV.*

YOU CAN DEPEND ON DOW



New! . . . from Morse Chain

Morse "Timing®" Belts

Stronger, lighter, slip-proof drives from the longtime leader in power transmission!

EXCLUSIVE!

Only Morse offers all 4 of these basic power transmission drives: Roller Chain, Silent Chain, Hy-Vo Drives, and "Timing" Belts. Your Morse distributor has no ax to grind in favor of one or two types of drives—he gives you a truly impartial analysis of your power transmission problems. Call him today!

Here's why *Morse* "Timing" Belts are important to *you:* For the first time, you can get these versatile, job-proved drives from a specialist with years of experience in every phase of mechanical power transmission!

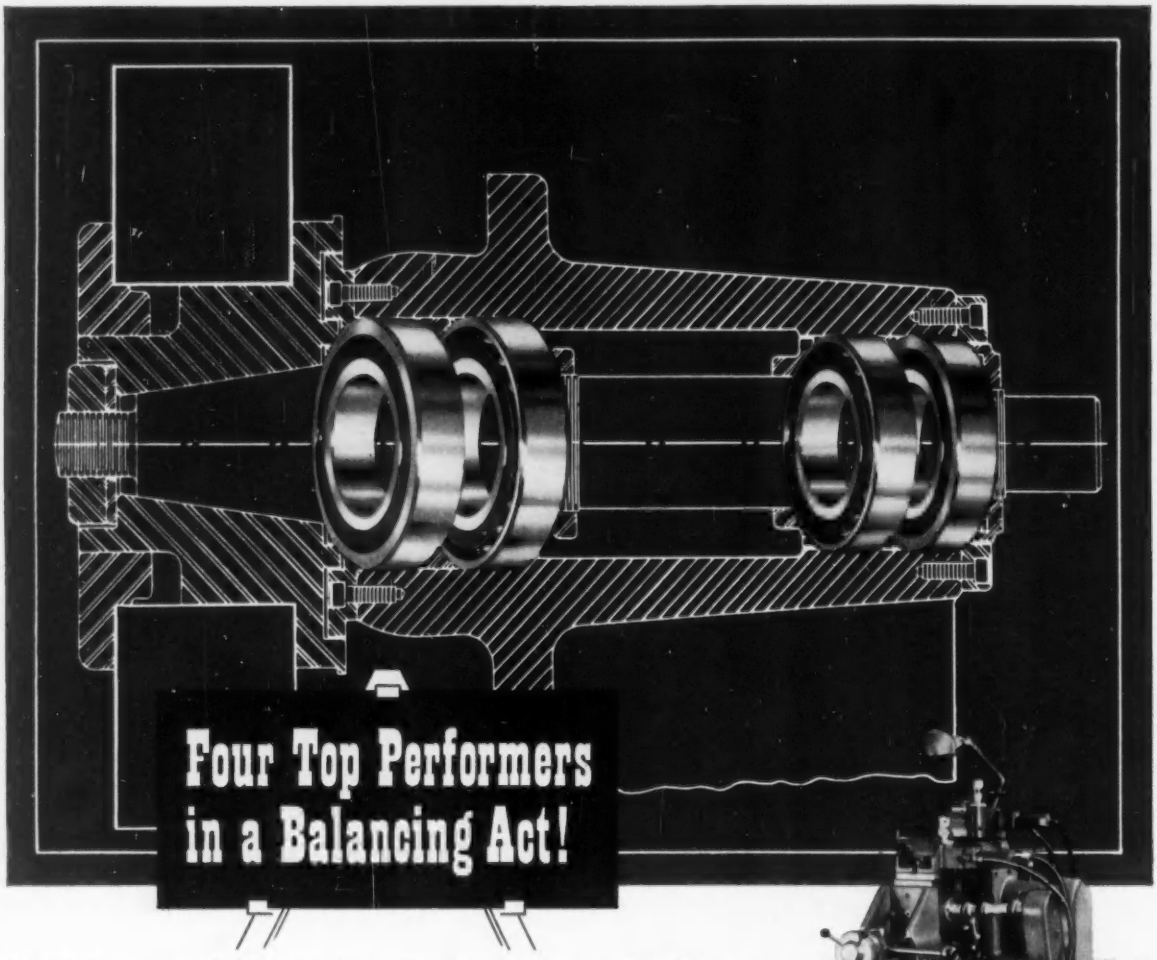
Along with seasoned engineering know-how, Morse gives you the convenience of a complete line to choose from: 0-16,000 FPM; 1/1000 HP to 1,000 HP; in stock or made-to-order drives.

Whether or not you already use timing belts, it will pay you to get all the facts on *Morse* "Timing" Belts from your local Morse distributor. You'll find him listed in the Yellow Pages under "Power Transmission," or write: *MORSE CHAIN COMPANY, DEPT. 4-28, ITHACA, NEW YORK. Export Sales: Borg-Warner International, Chicago 3, Illinois.*

IN POWER TRANSMISSION
THE TOUGH JOBS COME TO

MORSE BW

*Trademark



Four Top Performers in a Balancing Act!

To assure true spindle balance, close running accuracy, and vibrationless performance, Royal Master mounts the massive, heat-treated alloy work wheel spindle of its TG-12 centerless grinder on four Fafnir Super Precision Ball Bearings. The spindle assembly itself is mounted directly into the normalized, stress-relieved, close-grained grey iron head stock.

Besides providing proper balance and smooth spindle operation, the Fafnir Preloaded Super Precision Ball Bearings used in the TG-12 eliminate spindle warm-up time—an important feature where the machine is used intermittently. Moreover, relubrication of the bearings is never required. They are lubricated for life when the machine is assembled.

This Royal Master bearing application is a typical example of the Fafnir "attitude and aptitude"—a way of looking at bearing requirements from the designer's point of view and coming up with the right bearing to fit the need. Perhaps the Fafnir approach can be of help to you in finding more economical and satisfactory answers to bearing problems. Write The Fafnir Bearing Company, New Britain, Connecticut.

Royal Master TG-12 Centerless Grinder, Fafnir equipped, is designed for thru-feed, plunge feed, and infeed grinding. It has successfully ground materials ranging from plastics to tungsten carbide. Features include accessibility of both sides of wheel from operating position, for high output and fast checking.

◀ Fafnir preloaded, angular-contact, super-precision ball bearings with composition or bronze retainers are made to highest industry-approved tolerances. Single or duplex bearings like this are used widely on spindle applications.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

Brush wire, crimped (as shown) or straight, now produced in multiple strand, and furnished in coils or straight hanks depending on wire size.

How a **new idea in wire** *cleaned up a brush production problem*

• Maybe you can profit by the kind of interest and action applied to customers' problems by the Worcester Wire Works Division of National-Standard. Take wire brush manufacture for example . . .

Until recently, brush manufacturers had to cut through a coil of wire, then gather by hand and by guesswork the approximate number of wires for the type of brush in production. Naturally this involved a lot of cut-off waste, plus the wire lost through faulty guesswork.

Now, to overcome this waste, Worcester Wire Works has developed ways to produce and furnish wire in predetermined bunches (up to 400 wires per bunch) with *exactly* the right number of wires for a given brush. Much costly loss is eliminated, more brushes are produced per pound of wire, and production is speeded.

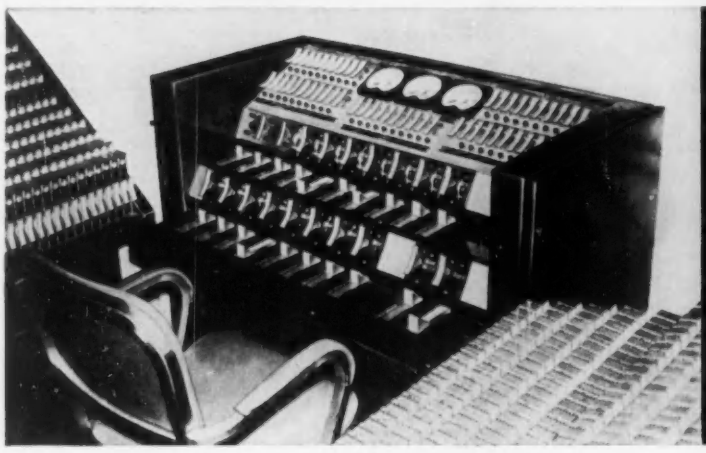
The point is, Worcester Wire Works people specialize in more than quality wire. They also specialize in the kind of service and exploration that time and again cuts costs for customers. Better check with them on your wire needs. You'll like the way they do business.

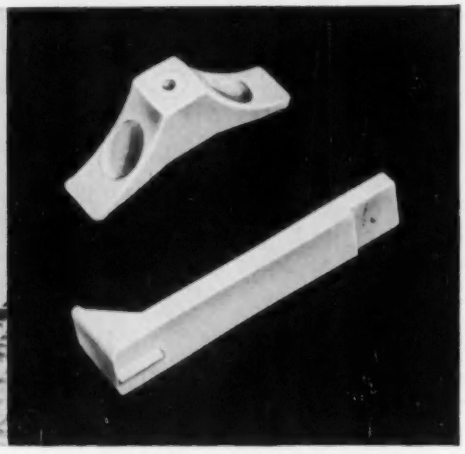
NATIONAL NS NATIONAL-STANDARD **STANDARD**

DIVISIONS: NATIONAL-STANDARD, Niles, Mich.; *fine wire, stainless, music spring and plated wires* • WORCESTER WIRE WORKS, Worcester, Mass.; *high and low carbon specialty wires*
WAGNER LITHO MACHINERY, Secaucus, N. J.; *metal decorating equipment* • ATHENIA STEEL, Clifton, N. J.; *flat, high carbon spring steels* • REYNOLDS WIRE, Dixon, Ill.; *industrial wire cloth*

CYANAMID

PLASTICS NEWSFRONT



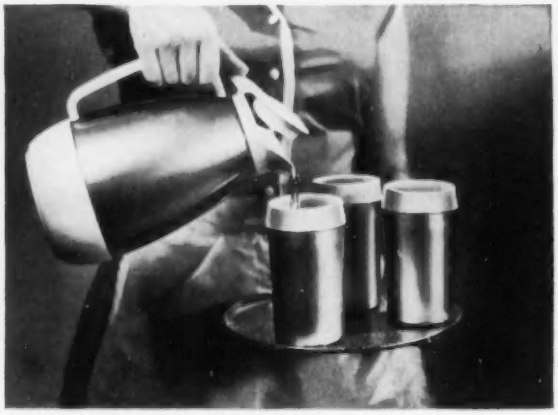


Plastic Keys Conduct an Orchestra of Light

One operator can play infinite variations in stage-lighting effects on the plastic "keys" of the Lumitron Lighting Control System. Control handles and slide bars are molded of BEETLE® urea plastic, an excellent dielectric which requires no insulation. Permanent, molded-in colors permit quick circuit identification. Developed by Metropolitan Electric Manufacturing Company, the Lumitron has an excellent record of performance.

"Five-in-One" Counter-Top Appliance Features CYMEL® Plastic Accessories

The new multipurpose NuTone Food Center operates a mixer, blender, meat grinder, knife sharpener and fruit juicer from one motor that can be set flush in a counter top Counter clutter, tangles of electric cords and heavy separate appliances are eliminated. A gleaming white 3½-quart bowl made of CYMEL melamine molding compound serves the mixer and juicer. CYMEL makes the bowl lightweight, dent-proof and easy to handle. The bowl is molded for NuTone, Inc., by Prolon Plastics Division of Prophylactic Brush Co.



New Insulated Beverage Set Joins Growing List of Boilable CYMAC® Housewares

Suitable equally for hot or cold beverages, these new double-shelled Thermo-Serve tumblers and pitchers are molded of CYMAC 201 methylstyrene, Cyanamid's new heat-resistant thermoplastic. This CYMAC ware resists staining by fruit acids, coffee and other beverages, and can be washed in boiling hot water, even in automatic dishwashers, without cracking or warping. All parts are injection-molded by NFC Engineering Company and sealed together under heat.

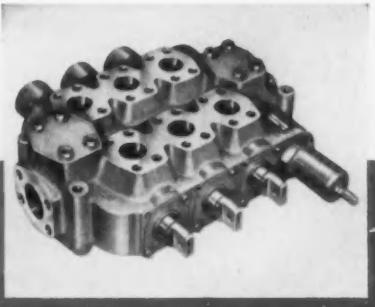
AMERICAN CYANAMID COMPANY
PLASTICS AND RESINS DIVISION
40A Rockefeller Plaza, New York 20, N. Y.
In Canada: North American Cyanamid Limited, Toronto and Montreal
Offices in: Boston • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Detroit
Los Angeles • New York • Oakland • Philadelphia • St. Louis • Seattle

CYANAMID Plastics and Resins Division

Save Power on Your Mobile Equipment with—

HYDRECO®

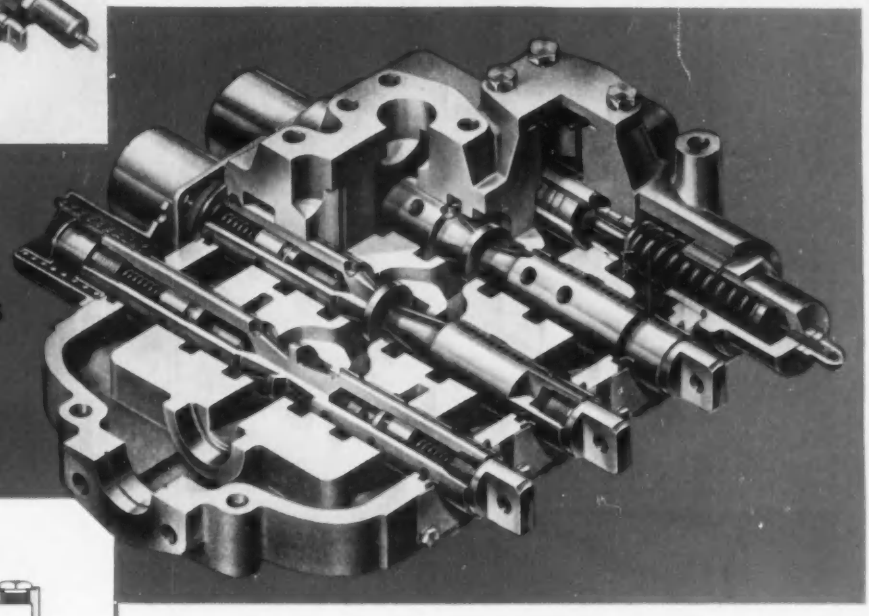
HOLLOW PLUNGER FLUID POWER VALVES

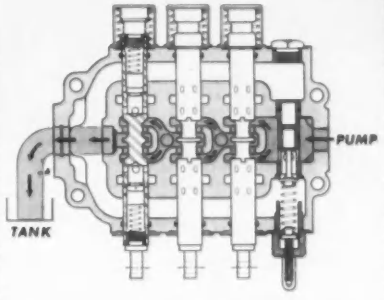


5 to 150 gpm

1 to 6 Plungers

2000 psi





This schematic sketch of the V-26 three-way HYDRECO Valve shows the restriction-free idling flow path of the exclusive HYDRECO Hollow Plunger Valve design.

When you consume fluid power needlessly you suffer not only waste of power, but also excessive heat generation. This multiplies many problems—wear, pump slippage, and deterioration of seals and hydraulic fluid.

HYDRECO Valves are designed with exceptional efficiency to take advantage of this opportunity to economize. They provide an idling flow path around the plungers that is more than ample . . . actually twice normal size. Back pressure during idling is negligible . . . horsepower consumption is therefore less.

This is but one of many significant plus factors in HYDRECO engineering. It also is one of the reasons why the HYDRECO Plunger design gives greater dependability, power-saving control and ease of operation to outstanding earth moving, farm and materials handling applications.

Member NFPA

Write . . .

for detailed information on the full line of HYDRECO Hollow Plunger Valves.

THE NEW YORK AIR BRAKE COMPANY

KALAMAZOO DIVISION • KALAMAZOO, MICHIGAN

Kalamazoo Division
The New York Air Brake Company
9012-2 East Michigan, Kalamazoo, Mich.

Please send me bulletins fully describing HYDRECO Valves for Mobile Equipment.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

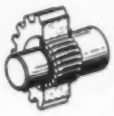
Now you can get highest capacity at lowest cost with Torrington Needle Rollers

A hardened shaft, a hardened housing, and precision Torrington Needle Rollers provide the most economical, highest capacity anti-friction assembly you can obtain.

Six roller end shapes permit design flexibility whether the requirement be maximum effective roller length, proper fillet clearances or greater lip retainment. Torrington Needle Rollers are available in a complete line meeting SAE and AFBMA specifications. Torrington standards for material, heat treat, tolerance and finish of Needle Rollers are the highest in the industry.

Operating results with Needle Rollers depend on careful design of mating parts. Torrington's Engineering Department, with extensive experience in Needle Roller application, will be glad to give you technical advice on your needs. *The Torrington Company*, Torrington, Conn.—and South Bend 21, Ind.

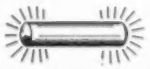
Full complement of small diameter rollers insures maximum number of contact lines in load zone for high radial capacity in minimum space.



Mounted without races between hardened shaft and hardened housing (RC-60 recommended), Torrington Needle Rollers allow largest possible shaft diameters.

Carefully hardened, ground and lapped high carbon chrome steel makes each Torrington Needle Roller a precision part for long life performance.

Close tolerances are assured by stringent quality controls. Standard OD tolerance is .0092", but Torrington Needle Rollers can be supplied with tolerance of .00005". Tolerance on length depends on end shape.



Fine finish reduces friction to a minimum. Torrington Needle Rollers are usually polished to 4-6 rms, but finishes as fine as 1-3 are available on special order.

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • BALL • NEEDLE ROLLERS • THRUST

premium on purity

From the cow to the container, the purity and delicate flavor of dairy products must be protected. Dairy equipment made of stainless steel resists corrosion, imparts no odor to the product and is easy to keep clean and sterile. The highest quality dairy equipment is designed, improved and protected with McLOUTH STAINLESS STEEL.

specify

McLOUTH STAINLESS STEEL

HIGH QUALITY SHEET AND STRIP

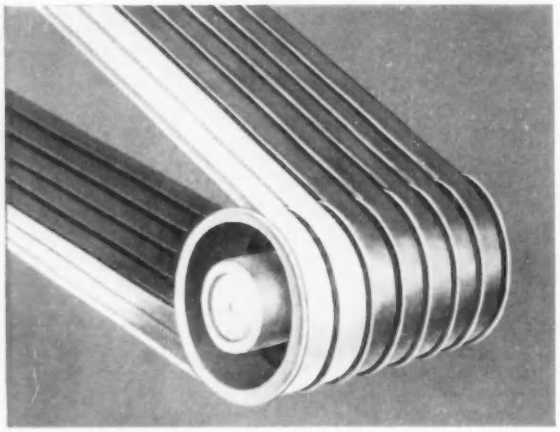
for the dairy industry

McLOUTH STEEL CORPORATION DETROIT, MICHIGAN

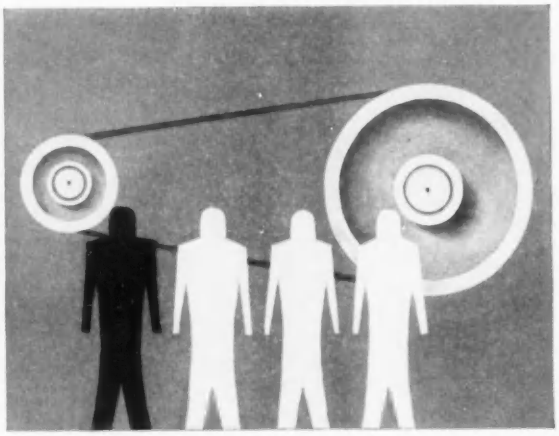
MANUFACTURERS OF STAINLESS AND CARBON STEELS

Why V-belts reinforced with DACRON give versatility in design, economy in maintenance

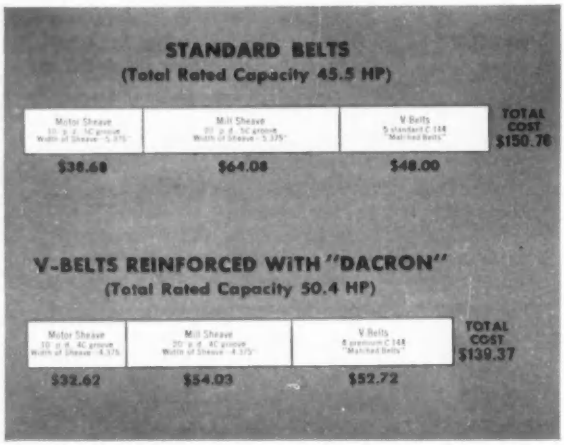
REG. U. S. PAT. OFF.



SPACE-SAVING DESIGN. The extra strength of V-belts reinforced with Du Pont "Dacron"* polyester fiber satisfies the demand for more compact, more economical belt drives. Designers find that fewer and smaller belts and sheaves can carry the load. In a typical case, 5 belts made with "Dacron" did the work of 7 conventional belts.



LESS MAINTENANCE. Stronger, longer-wearing V-belts reinforced with "Dacron" are made to operate continuously under severe shock loads without costly maintenance expense. They stretch less, have longer flex life . . . eliminate the excessive cost of frequent downtime for belt adjustment . . . a big saving in operating expense.



LOWER DRIVE COST. Compare cost and capacity of V-belts reinforced with "Dacron" against standard belts. You'll find that belts made with "Dacron" have increased horsepower capacity, give lower initial drive cost, easier upkeep . . . in every way a far greater dollar-for-dollar value.

"Lasted 52 times longer than regular V-belts," reports a user of belts made with "Dacron". Despite continuous rugged use, only one belt change was necessary in five years' operation. "Dacron" yields slightly under high impact—but resists stretch. And the low moisture regain of "Dacron"—only 0.4%—assures dimensional stability to changes in humidity . . . less time spent in matching belts.

For the next drive you design or install, consider the advantages of V-belts made with "Dacron". Du Pont makes the "Dacron" used by belt manufacturers in producing their finest-quality V-belts. E. I. du Pont de Nemours & Co. (Inc.), Textile Fibers Department, Wilmington 98, Delaware.

*"Dacron" is Du Pont's registered trademark for its polyester fiber.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

V-BELTS OF "DACRON" transmit more horsepower . . . stand greater shock loads . . . give longer flex life . . . give greater opportunities for machine-design improvement.

long-run power by Allis-Chalmers

If you specify "Allis-Chalmers motors or equal"

. . . remember that the "equal" is possible only in two respects: price and nameplate specifications. You can't match the *long-run power* of Allis-Chalmers motors.

Double-shielded bearings guarded against dirt and over-greasing . . . provision for elimination of moisture condensation . . . practically indestructible rotor design . . . more cooling surface . . . more iron and copper content — these are the features (with others) that make up long-run power. These are the features that give Allis-Chalmers motors "plus" performance that can't be equalled.

Find out more about the motors with long-run power from your A-C representative or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5663

R B&W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

Technical-ities

By John S. Davey

Select proper bolt diameter

An erroneous rule of thumb worth forgetting is that no bolt under ⅝" should be used where fastened members are under stress. Yet bolts ½-inch and smaller take plenty of external loading.

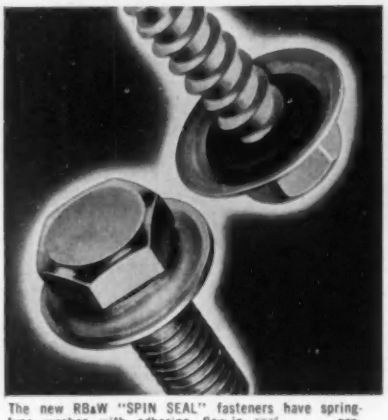
HOW TO LOOK AT IT

Primarily, you have to satisfy the stress requirements . . . the load. So select bolts on that same basis: the actual strength to sustain that load.

Calculating the strength requirements will tell you what bolt tensile, size, and number you need. If smaller bolts suffice, use them to avoid the penalty of overdesign. Holes can be smaller which means faster drilling and tapping. You have a chance to save materials since with smaller bolt holes, fastened members can often be made smaller too. You may also be able to standardize on a single size, saving assembly-line time.

SIZE VS. SAFETY

Remember that for a given grade of material, size tells you *capacity* of a bolt, not its *safety*. If you *tighten* a bolt to capacity, then you get safety. That's why a smaller bolt properly tightened is better and safer than a larger bolt sloppily tightened, especially where the loads are dynamic. Obviously, you reduce risk of under-torqued bolts as you reduce their size.



The new RB&W "SPIN SEAL" fasteners have spring-type washer with adhering flow-in seal . . . pre-assembled to standard machine or tapping screw.

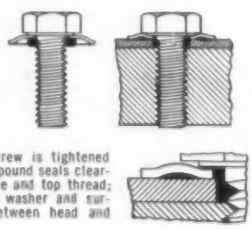
Flow-in sealant is confined by washer. Note how seal fills space under head and flows around and into threads in tightened SPIN-SEAL screw.

New SPIN-SEAL* screws give leakproof fastening

Here is a new type of composite fastener that seals by means of a unique flow-in sealant and washer.

ASSURES TRIPLE SEAL

Concave in shape, the heat treated springy washer confines and controls the flow of sealing compound. Tightening the screw forces sealant into various spaces around (1) threads, (2) head and (3) clearance hole to give hermetic sealing.



When screw is tightened the compound seals clearance hole and top thread; between washer and surface; between head and washer.

The washer has ability to conform to curved surfaces and still seal securely against hydrostatic pressures and wind driven water. Its spring tension and flat rim give the added advantage of dynamic metal to metal seal.

ONLY THE SCREW TURNS

Washer does not turn with the screw. This prevents twisting or tearing the sealing "gasket", marring of polished surfaces, or gouging of painted finishes.

The flow-in gasketing compound is plastic rather than elastic. Stable and non aging, it won't split or ozone-check under pressure. It gives controlled flow into clearance spaces. Compounds are available to seal out water or oil.

Send for Bulletin SS-1 which gives details on RB&W "SPIN-SEAL" fasteners. Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y. *T.M.

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

PERSPECTIVES

in design and development . . .

Inching Up On the Inch

An odd situation exists in this country with our system of weights and measures. We have legalized the metric system of weights and measures, which is not in common use, yet we have never formerly accepted the system of weights and measures we do use.

It was not until after the Civil War, following much haranguing dating back to George Washington's time, that Congress took the first formal steps to legalize a system of weights and measures—not the system in common use, but the metric system which had been rejected previously in 1795. While the Act of 1866 legally accepted the metric system for any "contract or dealing or pleading in court," the Act also included a table of conversion factors which "may be lawfully used" in going from one system to the other. Apparently Congress intended the table only as an approximation to the true ratio of the units in the two systems, for the meter was given as equal to 39.37 in., while the millimeter was rounded off to equal 0.0394 inch.

How Much Is an Inch?

Still, Dr. A. V. Astin, Director of the National Bureau of Standards says, "The inch is not yet a uniquely defined unit of length. There are now at least two 'inches' in use in the United States, and three among the inch-using nations of the world." Speaking at a Bedford, Mass., meeting of the Dimensional Standards & Metrology Div. of the American Ordinance Association, Dr. Astin said, "Advances in modern industrial technology, where the inch is deeply entrenched as the primary unit of measurement, have now reached a stage where efficient interchangeability is impaired by uncertainties in master laboratory standards of as much as a millionth of an inch. And this tolerance is less than the difference between the various inches now in use."

A program has been underway for the past two years to develop superior gage blocks and other measurement techniques that can be reliably certified to one or two 10-millionths of an inch. Most of the urging for such a program came from the machine tool industry.

Toward an Atomic Standard

One of the problems encountered is with the international meter, from which our own length standards are taken. This meter has an accuracy of about one part in 10 million, which is not quite precise enough to permit transferring to end standards of a 10-millionth part of an inch. This problem has been recognized for some time. But under the guidance of the International Committee of Weights and Measures, work is in progress in all of the major national standardizing laboratories in the world toward an atomic standard for length measurement. By 1960, agreement should be reached on using the wavelength corresponding to a specific energy transition of a specific type of atom for all length measurements. According to the most recent reports, the favored standard is an orange line of the element Krypton 86.

Dr. Astin said that the differences between the inches of the US, Canada and England are such that a precise reference standard, such as an end standard or gage block calibrated according to one of these nations, will probably fail to meet the tolerances in the other two. These differences resulted in some confusion and inefficiencies during World War II.

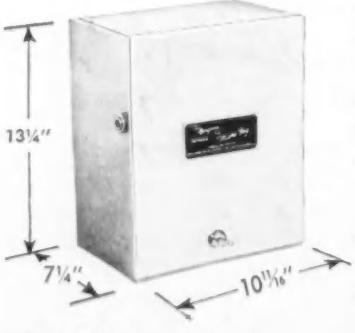
(Continued on page 63)

Norgren MICRO-FOG LUBRICATION

NEW...

Compact, Tamper-Proof Cabinet Units

lubricate all bearings, gears, chains and cams on a machine



1 QT. OR 2 QT. OIL CAPACITY
200 OR 300 BEARING INCH RATINGS

These new Norgren units provide ideal lubrication by applying just the right amount of air-borne oil fog to all bearing surfaces. The standard unit includes an automatic-drain air line filter, a solenoid valve, a pressure regulator, a pressure switch and a MICRO-FOG Lubricator . . . *and provides the following important advantages:*

- **TAMPER-PROOF** — Totally enclosed key-locked cabinet prevents tampering.
- **SPLASH-PROOF** — Coolant and corrosive liquids cannot reach interior of enclosure.
- **CONVENIENT TO SERVICE** — Removable one-piece top and side panel — secured by key lock — provides easy access for authorized personnel. Visual oil feed is proof of lubrication. Oil level gauge glass provided on lubricator.
- **SAFEGUARDS MACHINE COMPONENTS** — Pressure switch actuates alarm or shuts down machine if air pressure fails.
- **HEATER AND OIL LEVEL CONTROL OPTIONAL** — Thermostatically-controlled Heater, for 1 Qt. units, maintains uniform lubricant temperature and viscosity. Oil level control actuates alarm or stops machine when oil needs replenishing.

For complete information, call your nearby Norgren Representative listed in your telephone directory — or WRITE FACTORY FOR NEW No. 900 CATALOG.

C. A. NORGREN CO.

3428 SOUTH ELATI STREET — ENGLEWOOD, COLORADO

Map Makers Oppose Metric System

In 1938 the 2.54-centimeter inch was again proposed (previous attempt in 1902) by NBS as the standard for the English dimensional measures. But this time the opposition came from civil engineers, map makers and the Coast and Geodetic Survey. They claimed that an inch was 2.540005 cm. The reason for this opposition is no small problem, and it still exists for the Coast and Geodetic Survey if its standard of measurement is changed. The reason is this:

The C&GS has established plane coordinate map systems for each of the 48 States. Coordinates of about 150,000 triangulation and transverse points have been established and the values published in both feet and meters. Surveyors use them to fix boundaries all over the country. Changing the inch to equal an exact 2.54 cm would change the proper values for these reference counts by as much as 3 to 4 ft. Of course none of the locations of these points are known to this accuracy, but the coordinates of the various reference points are given to the nearest foot. Furthermore, the foot values of these points in many States are the basis of much legislative action. It was because of the opposition to this problem that the 1938 proposition was not accepted.

In 1946 another move was made to get legislation that would define the inch as 2.54 cm. This time the Army and Navy supported the move, but the same opposition prevented its being approved.

How the Length Standards Compare

The length standard in England is the Imperial Standard Yard, a bronze-bar measurement established by Act of Parliament in 1878. That the bronze bar has shrunk since then has been evidenced by the following comparisons made with the international meter:

In 1895=25.399978 mm.
In 1922=25.399956 mm.
In 1932=25.399950 mm.
In 1947=25.399931 mm.

In 1951 a British Committee on Weights and Measures recommended that the Imperial standards be abandoned, and the metric measures be adopted. The yard was given as equal to 91.44 cm, or 2.54 cm to the inch.

In the same year Canada set the yard as the unit of length with its value based upon the international meter, or equivalent to 2.54 cm to the inch.

A Proposal

Australia also has indicated a preference for th 2.54-cm inch. Therefore, with all English-speaking countries in such agreement, Dr. Astin proposed at the Bedford meeting that "efforts be initiated to establish an international yard through negotiations with representatives of the major English-speaking nations. The international yard would be based on the international meter and defined as 0.9144 meter exactly, and the international inch would be defined equal to 2.54 cm. This value is exactly the Canadian standard and about midway between the US and British standard. This approach would not interfere with the C&GS work."

Dr. Astin also suggested that work be undertaken to establish an international pound and gallon. As based on the international kilogram, the pound values in use by US, Canada and Britain are not far apart, and the proposed new value is within one part in 10 million of the present reference values in each of the three nations.

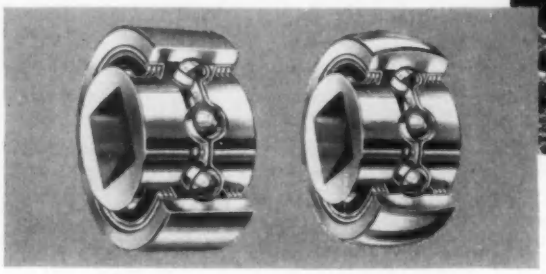
However, the US and the Imperial gallons are far apart. At present it is: 1 Imperial gallon = 1.20094 US gallons. The British indicate they will be willing to change this to equal 1.201 US gallons, permitting simple conversions. As Dr. Astin says, "For the average consumer the present ratio is: 1 Imperial gallon = 6 US fifths. —Paul Anderson

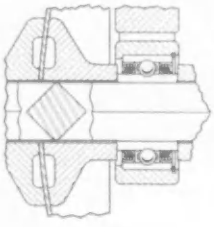
ND FACTS

DIRT SEALED OUT GREASE SEALED IN

With New Departure heavy duty disc bearings, the performance proved triple lip seals keep lubricant *in* bearings—dirt, dust and wear sealed *out*.

Here is new bearing dependability . . . virtually service-free operation . . . for disc harrow buyers. Bearings are available with cylindrical or spherical outer rings, and square or round bores—outstanding examples of bearings engineered by New Departure to simplify mounting design and cut machinery costs. Remember, too, experienced New Departure sales engineers are always at your service.



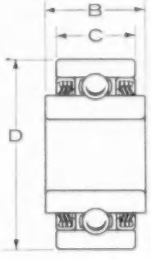


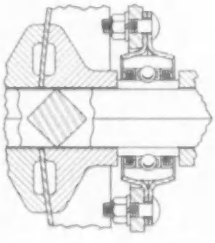
TYPE II

DIMENSIONS — TYPE II — CYLINDRICAL O.D.

Bearing No.	Shaft Size II		O.D. +.000 −.001	Ring Widths ±.005	
Sealed	Nominal	Max.	D	Inner B	Outer C
AS4508AD	1" Square	1.035	3.150	1.688	1.312
AS4508BD	1⅛" Square	1.120	3.150	1.688	1.312
AS4509AD	1¼" Square	1.285	3.346	1.688	1.312
AS4511AD	1½" Square	1.536	4.000	1.750	1.438
AS4508ED	1½" Round	1.535	3.150	1.688	1.312

For easy, simple mounting in cast housings. Square or round bore. Prelubricated and sealed for life.



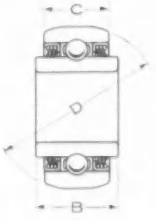


TYPE III

DIMENSIONS — TYPE III — SPHERICAL O.D.

Bearing No.	Shaft Size III		Spherical O.D. ±.005	Width ±.005	
Sealed	Nominal	Max.	D	Inner B	Outer C
AS4508FC	⅞" Square	.905	3.438	1.688	1.312
AS4508AC	1" Square	1.035	3.438	1.688	1.312
AS4508BC	1⅛" Square	1.120	3.438	1.688	1.312
AS4511AC	1½" Square	1.536	4.125	1.750	1.438
AS4508DC	1⅛" Round	1.192	3.438	1.688	1.312
AS4509BC	1¾" Round	1.780	3.438	1.688	1.312

Spherical outer ring for alignability in flange mounting, square or round bore, prelubricated and sealed for life.



1908–1958 GM FORWARD FROM FIFTY

Send for complete details on Heavy-Duty Disc Bearings

ND NEW DEPARTURE

DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL

Product Engineering

February 17, 1958

FACE SAVED, SHIRT LOST

We Americans have long prated of sportsmanship—playing the game for the game, being a good loser and all that. Actually, we lost the sporting concept a long time ago and we play games, politics, business and life itself strictly to win.

We don't lose gracefully either. When we're down, we immediately seek some reason beyond our own inadequacy. And at this curious point—too late—team spirit comes alive, and everyone else helps the loser find excuses. We consider Oriental emphasis on face saving as a curious racial custom, but we do more face saving than any Oriental ever did—man, company, industry and nation.

The man who loses a golf match, a job, or a wife promptly finds some reason in his childhood for the failure. No company's losses are the result of poor management or bad judgment—they stem from "industry-wide conditions." No industry loses position because of complacency either—it's always "fickle public taste." And our national failure at rocketry brought forth all sorts of rationalizations.

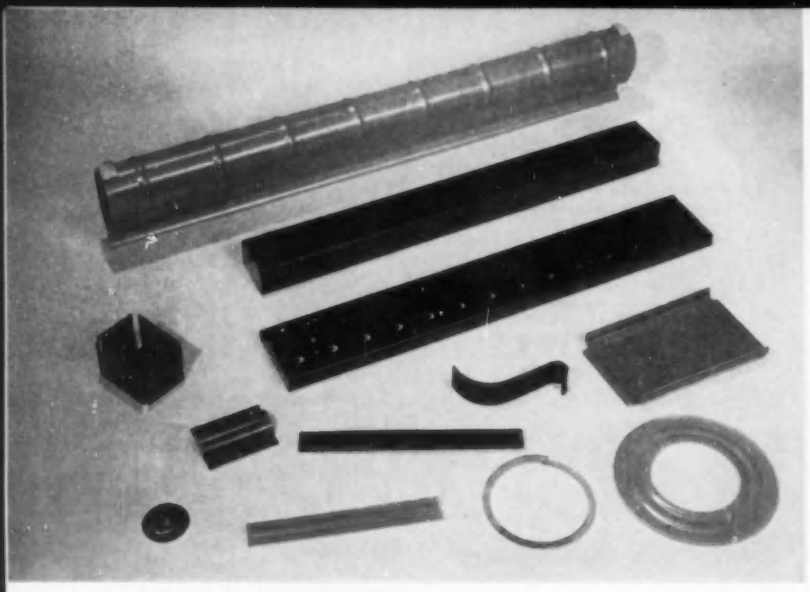
If you've been able to get past the missile headlines in the papers, you may have noticed that many industries and companies have reported 1957 as their "third-best year", with seeming satisfaction rather than sorrow. Take steel as a case in point: 1955 production was 117 million tons, 1956 was 115 million, and 1957 was 113 million. Says the released news, "Steel experienced the third best year in its history. . ." Or the rubber industry: "The entire year (of 1958) . . . should be good enough to rank just below the best two or three years the country has enjoyed. . ."

At whom are such statements aimed? Why should "third best" be laudable? As an engineer, how would you feel if your most recent design was rated your third best? What of your added experience and knowledge since you made the supposed "best" design?

Let's stop kidding ourselves. Some years we do well, some years not so well. Population is rising at a rate of 1.7% a year, gross national product at more than twice this, so theoretically each year should be above the last. But personal fortunes, company development, industry advancements and national position do not follow a constant curve but a sawtoothed line.

The important thing is to keep the objective in mind and to evaluate results against it, not against some passing milestone. So you lose, or drop back. This is a temporary situation, unless you're so busy excusing it that you fail to put sufficient effort into bettering it next time.

That's the principal problem with face saving—you may save your face and lose your shirt.



when cost counts...

POST-FORMED PHENOLIC LAMINATES

Shaping parts from pre-laminated sheet stock is often cheaper than molding and laminating simultaneously—and post-formed parts are just as good, often better. Here's how to design for this economical process.

How to cut cost on those plastic parts requiring high dielectric strength, chemical resistance, and good mechanical properties? A good way is to heat a special grade of thermosetting phenolic laminate, form it in dies, then cool to retain the shape.

For simple shapes like angles and channels, such post-formed parts cost about 25% less than molded parts—and the necessary dies will be about 20% cheaper. More complex shapes can show savings too. In any case, each part should be studied to compare the cost of post-forming from sheet stock with cost of molding the shape during the laminating process.

Economy of post-forming phenolic laminates results from four features of the process:

- Dies are inexpensive—they can be made from easily shaped materials like hardwood, plastics, and light metals.
- Such dies can be quickly and inexpensively altered if design changes occur after a production run has started.
- Many thicknesses, shapes, and sizes can be handled: with interchangeable forming members in the die, or the die can be designed to handle several different parts at once.
- Heating equipment, generally standard infrared lamp ovens, is adapted easily to rapid production.

The two basic post-forming materials, paper-reinforced and cotton-reinforced, have the same phenolic base resin—modified to give some thermoplastic characteristics to a normally thermosetting material. Both laminates can be bent and drawn in post-forming operations, or used flat. Paper-reinforced grade goes into parts in the aircraft, refrigeration, textile, electrical appliance and allied fields when load-bearing is secondary. But when strength is essential, the cloth-reinforced type dominates.

The temperature range for post forming is narrow and heating becomes a critical step in the process. Heat must be applied rapidly and uniformly, so that internal temperature reaches the optimum 325 F in less than 1 sec per 0.001 in. of thickness. Laminate temperature should not exceed 350 F, and the heated blank must be transferred to the die and formed in less than 10 sec.

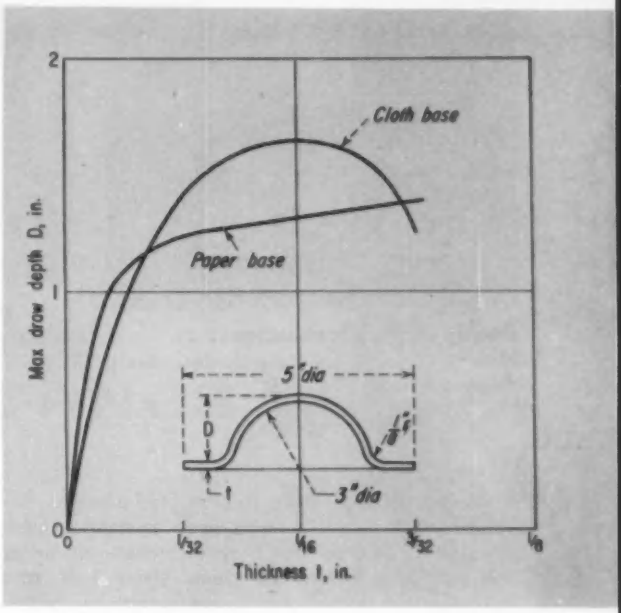
HEATING THE BLANK

Three heating methods are: infrared-lamp oven, heated platens, and infrared-strip heaters. Ovens offer widest adaptability—the material carriages, thermostatic controls, and workpiece visibility are readily adaptable to fast production. Aluminum platens heated with integral strip heaters are limited to laminate thicknesses below $\frac{1}{4}$ in. and long narrow areas; another disadvantage is that the workpiece is not visible. Temperature is usually controlled thermostatically, and a clamping system assures contact with the laminate at all points for uniform heating. The heated area exceeds the blank size by at least 2 in. along all edges.

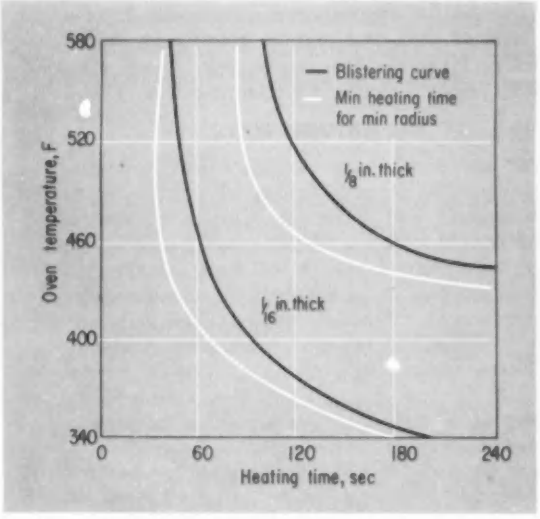
Infrared-strip heaters provide rapid, portable, and economical heating for laminate blanks in strip form—

HARRY STORCH, *Application Engineer*
Formica Corp.

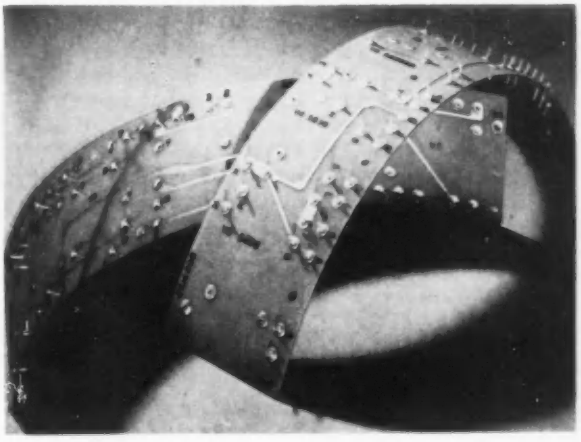
Infrared-lamp oven . . .
heats phenolic blanks for post-forming dies.



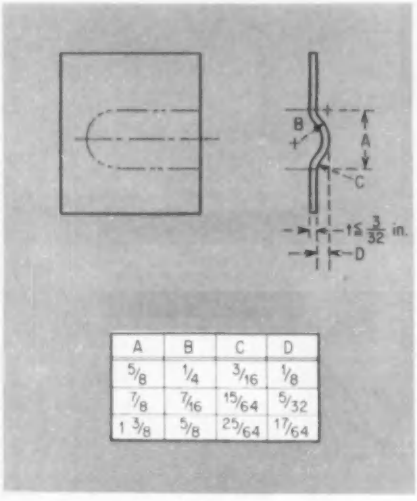
Drawing a sphere . . .
isn't easy, though cloth-reinforced phenolic can be drawn deeper than paper-reinforced type. Here's data on a 3-in.-dia. sphere, showing max depths for various thicknesses.



Time-temperature curves . . .
for post-forming in infrared-lamp oven. Minimum heating time is advantageous, but oven temperatures must be kept below blistering curves.



Printed circuits . . .
for Nike guided missile are made from copper-clad phenolic sheet, post-formed to have space.



A	B	C	D
5/8	1/4	3/16	1/8
7/8	7/16	15/64	5/32
1 3/8	5/8	25/64	17/64

Beads stiffen laminates . . .
below 3/32 in. thick and permit lighter parts if designed to these dimensions.

TABLE I—PROPERTIES OF POST-FORMED PHENOLIC LAMINATES

Property	Reinforced with: Cotton	Paper
Tensile strength, psi	10,000	9,200
Compressive strength, psi	36,000	34,000
Shear strength, psi	13,800	12,500
Flexure strength (flat), psi	20,000	14,700
Izod impact strength, ft-lb/in.	2.55	1.15
Thermal expansion coefficient, per °C × 10^{-5}		
lengthwise	2.0	2.2
crosswise	2.4	3.6
Max operating temperature, F		
part restrained	235	250
part unrestrained	160	160
Specific gravity	1.35	1.37
Dielectric strength, vpm		
1/16 in., perpendicular to laminations	230	400
Water absorption (1/16 in.), % in 25 hr	4.40	2.00

TABLE II—MINIMUM BEND RADII

Thickness, in.	Min Radius, in.
1/32	1/32
1/16	3/32
3/32	3/16
1/8	5/16
3/16	9/16
1/4	1
3/8	2 1/2

when post-forming angle sections, for example. For thicknesses to ⅛ in., a single heater is suitable; above this, double heaters—one from each side—are recommended. Strip heaters are placed about 3 in. from the workpiece, with baffles to concentrate the heat.

CHOICE OF DIES

Die materials depend on complexity of the post-formed part and number of parts produced. Hardwood is good for simple bends and shallow draws, and is especially adaptable for experimental short-run dies where quick results and low costs are essential. But hardwoods are sensitive to heat and unsuitable where dimensional stability and tolerances in the post-formed part are critical. Plastics, including certain phenolic laminates, wear better and so are satisfactory for longer runs. They are also more stable dimensionally; they machine better, and are more resistant to dents. Light metals like cast Kirksite and tempered aluminum are needed only when tolerance control demands them and the expense and longer machining is acceptable.

SHAPING THE PART

Most common post-forming operations are bending, drawing and, for added stiffness, beading. Residual stresses induced during bending will relax and give springback. For example, a bend post-formed to 90° in the die will open to 95° on removal. A die angle of 85° will give a 90° part. Springback requires three precautions: Keep specified bend radii as close to minimum as possible; make sure the part is uniformly heated to the correct post-forming temperature of 325 F; do not remove the part from the die until internal temperature has dropped below 180 F. Min bend limits for laminates of various thicknesses are shown in Table II.

Design limits on drawn parts are harder to establish. Most difficult draw is a spherical one. Cloth-reinforced phenolic can be drawn deeper than paper-reinforced because tensile strength is higher. Bead stiffeners are often added to parts with laminate thickness up to ⅛ in. For deep draws other than spheres and beads, such as flat dished parts, about 5° draft is required and bottom radii can be approximated from Table II. For more complex parts, trial runs are generally made with inexpensive maple dies that can be easily altered. This is also an excellent method for prototype work.

THE FINISHED LOOK

Most post-formed parts undergo secondary fabrication to complete the part—drilling, slotting, sawing to length, routing—and these are done with standard woodworking machinery. Shearing and punching are favored only when tolerances are loose enough. Assembly of the products is usually by squeeze-riveting or adhesive bonding. Spraying with an electrical-grade air-dry varnish will restore surfaces nicked or cut during any of these operations.

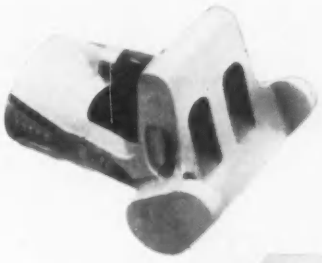
EDITOR'S NOTE: Some alternative methods for making low-cost plastic parts are covered in the following:

"Plastic Extrusions," Nov 25 '57, p 84, shows how extruders are adding fabrication steps that turn out finished parts at lower cost.

"How to Design Cost Out of Plastic Parts," Oct 14 '57, p 77, points out costly requirements, such as heavy wall sections and extra-close tolerances, that aren't always necessary. Charts classify materials and processes for ready reference.

"Epoxy Castings," June '57, p 135, discusses a lower cost alternative to metal or molded plastics for limited quantities of complex parts.

Added strength
and reliability were
built into these
aircraft control components, examples of . . .



HIGH-INTEGRITY ALUMINUM CASTINGS

RELIABLE ALUMINUM CASTINGS CAN BE MADE BY:

- **CHOOSING AN ALLOY WITH GOOD CASTABILITY**
- **DESIGNATING REQUIREMENTS OF CRITICAL AREAS**
- **CLOSELY CONTROLLING FOUNDRY TECHNIQUES, AND**
- **CORROBORATING FOUNDRY PRACTICE WITH TEST DATA**

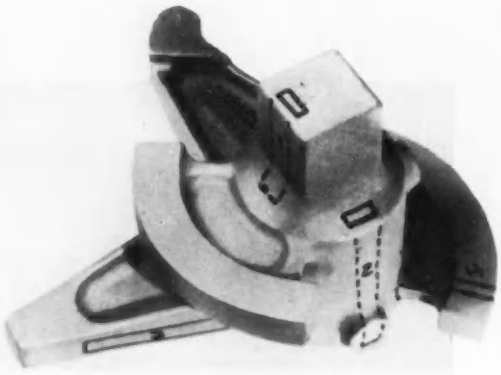
A. R. MEAD
Chief Metallurgist
Grumman Aircraft Engineering Corp.

Aluminum castings have been widely used because they have these major advantages:

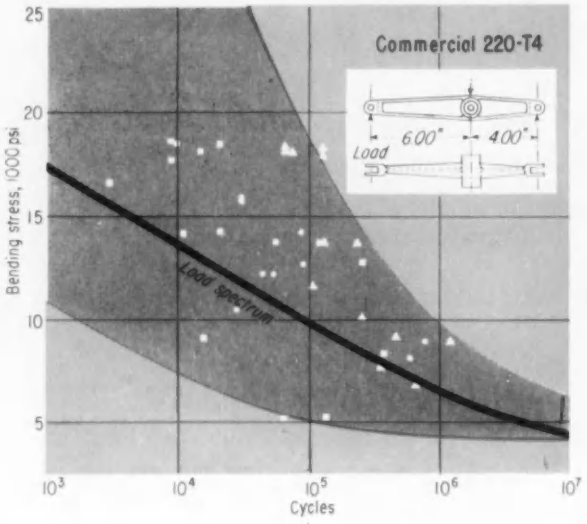
- Low tooling cost—patterns cost less than dies, so small quantities can be made economically.
- Short time required for delivery of finished parts.
- Intricate stiff shapes can be made that are too complex for other processes.
- No wide differences between transverse and longitudinal properties as with forgings, extrusions and rolled shapes.

But for critical uses that require minimum weight and low safety factors, aluminum castings have not been accepted as widely because their lack of uniformity lowers reliability and gives a minimum strength lower than that given by forgings. The difference between properties of test bars and castings reflects the greater difficulty in feeding intricate castings than simple test bars.

These properties, which are nonuniform in the same casting as well as from casting to casting, are the main objection to speci-



Four critical areas . . .
are designated for testing on this high-integrity aluminum aileron sector casting.



fying cast-aluminum-alloy parts for reliable structures. When these parts are specified, safety factors must be increased; this in turn increases dead weight without improving performance.

Materials are usually chosen from lists of mechanical properties taken from standard test bars. Actually the properties of an intricate part are often 25 to 50% lower than for test bars, so for critical parts, a safety factor large enough to insure no failure will increase the weight of the part beyond what is allowable in design. Specimens taken from actual castings will give more accurate properties and the design stresses could then be increased with better reliability.

Some alloys, particularly aluminum-magnesium, are difficult to cast in the completely sound condition. They give large amounts of dross, and have microporosity and sand reaction. The mechanical properties of these alloys are also depressed by minor contaminants—copper, iron, silicon and sodium—and under normal foundry practices have a wide spread of mechanical properties.

X-ray inspection is no cure-all either. Although cracks, shrinkage, porosity and some microshrinkage are revealed by difference in image density on the film, there is no positive correlation between density and strength. Poor X-ray quality reduces probability of good mechanical properties, but a good X-ray quality does not insure safety against failure if the mechanical properties are not consistent.

EIGHT STEPS TO RELIABILITY

Here's how to design for reliable, high-integrity aluminum castings:

- First determine need for high integrity. Unless required for safety or limited in space or weight, these castings should not be specified—they are expensive.
- Analyze stresses and determine type of loading. Specify on drawings those areas that are critical, and list properties required of these sections.
- Specify identification of the part with casting source, melt number, and heat-treat batch so the casting can be traced. Most specifications already require identification, so this need not add to costs.
- Choose material with best castability for the required strength. With such materials, the reliability is usually better and dimensional tolerances are closer.
- Obtain typical parts in sufficient quantity so test results will be statistically valid. Test parts under actual loading conditions and test specimens cut from critical areas. In no other way can true reliability be determined.
- Approve only those foundry practices that give reliable castings with consistent properties on testing.
- Set acceptance levels to the minimum that will give reliability needed. This will help lower costs.
- Specify sample testing on all parts after acceptance standards have been established. This procedure should be coordinated with inspection, where approval should be revoked if casting quality falls below minimum set or if rejects are excessive.

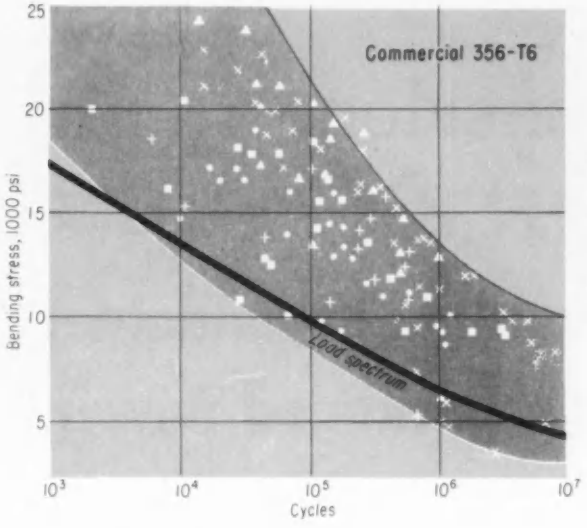
GRUMMAN MAKES IT WORK

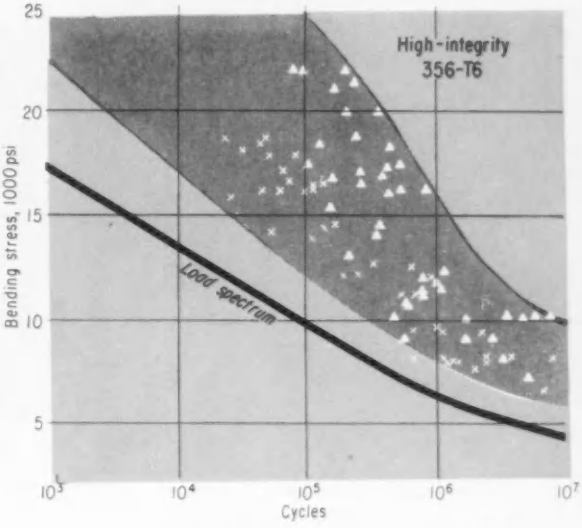
In a typical case; an evaluation was made to determine whether aluminum castings could be designed and obtained with the necessary reliability for aircraft control-system components. Because these parts were designed partially on a stiffness basis the stresses were comparatively low.

The complete stress analysis was made from variables such as number of flight hours, type of airplane, and other specific service requirements. The analysis—stress and number of times it was applied—was plotted into a loading spectrum. This loading spectrum showed that parts were loaded with maximum stresses for only a small portion of the total time.

From the components of the system, a test part was designed that was typical in cross-section. Once the performance levels were established for this part, the others did not have to be tested in detail.

To assure that good quality castings were tested,





In this typical case . . .
bending-fatigue tests show 220-T4 castings (chart on facing page) to be below required strength in several specimens. (Each symbol designates a part from one foundry.) Tests on commercial 356-T6 castings (chart, left) showed only 8% below specification but still not completely reliable. All high-integrity 356-T6 castings (above) have properties well above minimum required.

each casting was first inspected by X-ray, fluorescent penetrant, and chemical analysis, and given dimensional checks after machining.

Some foundries consistently produced castings on the high side of the dimensional tolerance while other foundries were on the low side. So to test the material fairly, the load was determined from the fracture plane, and the stress calculated from the actual cross-section.

The first group of 125 castings of 220 aluminum alloy tested gave widely varied test results—see first chart (opposite page). When these 220-T4 castings were good, they were very good but when they were bad they were far below acceptable standards. Many points on fatigue curves were below the minimum loading requirements and only one foundry produced fairly consistent castings. Even then, the 220-T4 castings from this foundry were on the borderline of the load spectrum, and not entirely reliable.

As a result, the specification was changed to 356-T6, which has slightly lower properties but is much easier to cast. The fatigue tests on the 356-T6 castings, second chart, indicated a narrower spread of properties and although several test results were below the required, the percentage of substandard points was much smaller than for 220-T4 castings.

The standard then set up for acceptance of production parts was the minimum X-ray quality in any three castings that would all meet static load testing. This inspection standard served initially to accept parts for production use but as production increased, the number of rejects increased. This showed that X-ray-acceptable, commercial-quality castings of a readily castable aluminum alloy did not have complete reliability even at low stress levels. Because inspection ruled out possibility of defective castings, the remaining way to get reliable castings was to closely control foundry practice.

A study of close control of foundry variables—chemistry, degassing, pouring temperature, molding sand, coremaking, cleaning and inspection showed that high-integrity 356-T6 castings with necessary narrow spread in mechanical properties could be produced. The controlled practices then gave high-integrity castings that exceeded 38,000 psi ultimate tensile strength, 28,000 psi yield strength, and 6% elongation in critical areas. Experience shows that easy-to-cast shapes can even be used up to 45,000 psi ultimate, 37,000 yield and have a 5% elongation.

These high-integrity castings allow a 25 to 50% increase in design stress, have superior surface finish, closer dimensional tolerances, and require less machining. Walls as thin as 0.10 in. can be cast. There are still variations in strength within the castings due to the shape, but specifying the properties wanted at critical areas can minimize the effects of these variations and thereby give good reliability.

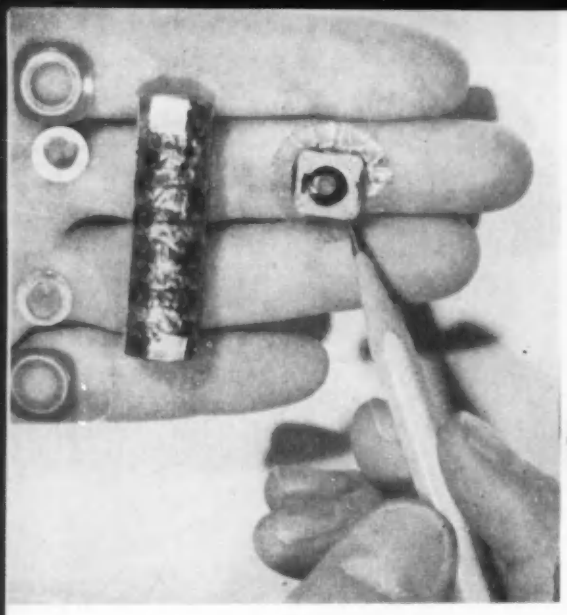
EDITOR'S NOTE: Recent articles on casting and other methods of working aluminum are:

"Aluminum Impact Extrusions," Nov 25, '57, p 72. Improved tooling broadens applications; parts can now be made in wider ranges of OD, length and wall thickness.

"Glascast Process," Oct 14, '57, p 68. New investment casting technique produces finer grain, better strength and ductility of parts; allows wider choice of materials.

"Color and Texture in Aluminum," Sept 30, '57, p 101. Surface treatments—mechanical, chemical and electrochemical—plus coloring methods peculiar to aluminum shown in full color.

"Castings as Strong as Forgings," June '57, p 170. Mold construction uses anodized aluminum combined with controlled pouring rate, is also adaptable to casting aluminum.



consider DRY CELLS for quiet, dependable, packaged power

J. J. COLEMAN
Vice-president
Burgess Battery Co., Freeport, Ill.

Today's batteries are becoming more powerful; the jobs they have to do are becoming easier thanks to better design of electrical products. It's time to examine the external-supply cord and ask, "Is it needed"? Here's a quick roundup of what the dry cell offers.

WHAT IS A DRY CELL?

A dry-cell battery, according to Webster, is one that can be tipped without losing the electrolyte. It can contain liquid, but spilling is prevented by sealing or by absorption in a porous reservoir within the cell.

The two common types are the modified Leclanche (the most used) and the mercury cell. The many-years-old Leclanche design, once built in a jar, is a zinc negative electrode separated from a carbon positive electrode by an electrolytic mix. Paper may separate the zinc from the mix to limit unwanted local electrolytic action. The electrolyte is liquid, soaked into porous material, and contains chemicals such as sal ammoniac and zinc chloride that ionize and establish flow of electric current from the zinc to the carbon. Since hydrogen gas would form in this voltaic action at the carbon positive pole and slow down the action, a 'depolarizer' such as manganese dioxide is included in the mix to prevent formation of hydrogen. The standard flashlight D cell (1¼ in. dia, 2¼ in. high) is a Leclanche Cell; it has a zinc can (negative electrode), chemical mix (electrolyte and depolarizer), and carbon rod in center (positive electrode).

A mercury cell (Ruben-Mallory) is also "dry" by definition. It has a zinc negative electrode separated from a depolarizing, mercuric-oxide, positive electrode by a potassium-hydroxide electrolyte. It has more power per unit volume but is more expensive than the similar Leclanche cell. Many other types are available; the silver-zinc ("Emergency Battery Power," Apr '57, p 182); wax electrolyte and gel electrolyte (Dec 2, '57, p 58); solid-electrolyte (silver, silver iodide, vanadium pentoxide, Oct '56, p 234); water-activated (silver- or cuprous-chloride, magnesium); indium-mercuric-oxide; rechargeable nickel-cadmium (hermetically sealed); and even nuclear (phosphor, promethium 147). One manufacturer will soon offer a silver-zinc battery package with transistorized converters for 110 v, 60-cycle operation—300 w for several hours. See p. 17. Also look for article on novel power sources in a forthcoming issue.

Most dry cells are "primary," meaning that a chemical action produces the current,—essentially irreversible. Some dry cells can be recharged, but the majority are throw-aways.

Dry cells may be stacked and paralleled to give practically any output. But reliability is decreased if too many cells are stacked in series–200 is the practical limit. Reasons: voltage, usually 1.5 per cell, is always at full value even with no current drain, and shorts or arcing can occur; and 200 possibilities exist for a single cell failure–the bad unit opens the whole series circuit. Current is limited only by space available for batteries, which come in many sizes. Two common types are the #6 cell (2.5 in. dia. x 6 in. high) and the D-cell (1¼ x 2¼), each 1.5 v.

National Bureau of Standards Circular 559, "Specifications for Dry Cells and Batteries," abstracted in the table, prescribes tests and limits of performance, all based on realistic intermittent duty. For example, each small "D" cell in a heavy industrial flashlight must provide the equivalent of 0.25 w in the external circuit for 12.5 hr. This approximates the energy consumed by a 25-w light bulb in 7.5 min, but a cell because of current drain limits will not release its energy at such a high rate.

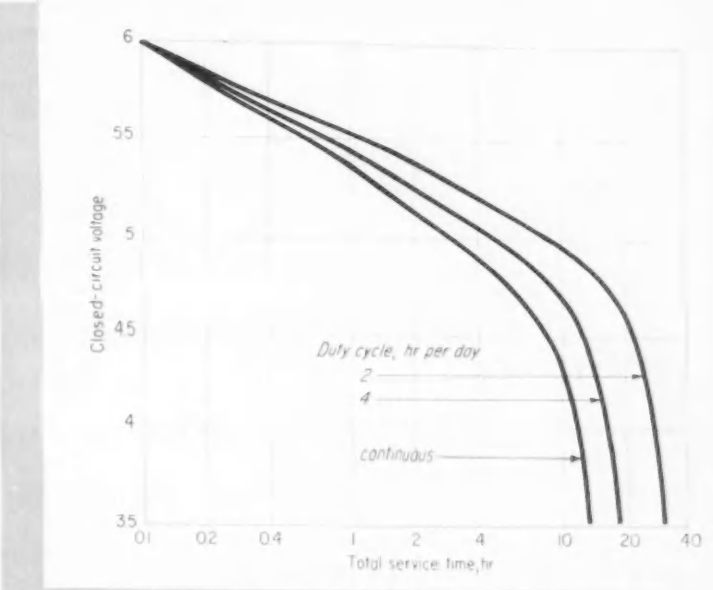
Each cell has chemical, resistance, heat-transfer, gas-absorption, and venting characteristics that establish how much current under what cycling conditions will cause saturation of the mix (with products of the reaction) or polarization of the positive electrode. An industrial battery, for example, may give 18 hr of service during the "Heavy Industrial" NBS test, and do only 1 hr better under the much easier "Light Industrial" test. But by substituting a special electrolytic mix it may last over 26 hr.

Six D-cells in series (9 v) drive a sequence-timing

WHAT IS EXPECTED OF BATTERIES

Based on typical NBS tests for qualifying dry-cell batteries at 70 F—revised here for single 1.5 v cell.

Test	Load resistance R, ohms	Cutoff (end-of-test) potential, E volts	Approx. output E^2/R watts	Intermittent timing			Total hours per week	Required life of typical "D" cell, hr
				"on" time, min.	number per day	days per wk		
Light intermittent	6.67	0.93	0.13	4	10	6	4.3	20
Heavy intermittent	2.67	0.85	0.27	60	2	7	14	not recommended
Heavy industrial, flashlight	4	1.1 and 0.9	0.25	4	32	7	14.9	12.5
Hearing aid	20	0.9	0.04	720	1	7	84	not recommended
"A" battery	25	1	0.04	240	1	7	28	70



Intermittent duty . . .
of only 2 hr per day more than doubles total lifetime compared with continuous drain for typical 6-v-lamp duty of 600 milliamp initial drain for a 75-cu in. Burgess TW-1 dry cell.

motor. Insulation can be tested for breakdown by 34 #6 cells (510 v); 4 cells (6 v) ring alarms, light lamps, and provide emergency ignition for small engines. Three "D" cells (4.5 v) run clocks. Low-power applications are limited.

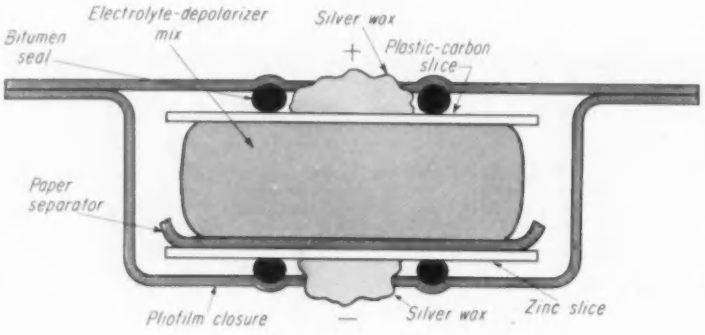
DON'T FORGET TEMPERATURE

Standard NBS ratings are at 70 F. Performance of a typical Leclanche dry cell drops to approximately 85% rated at 40 F and to 50% rated at 0 F. Below 0 F, output drops off rapidly. When brought back to room temperature, normal service results. Small increases above room temperature tend to improve output, but prolonged inactivity at elevated temperatures reduces service life.

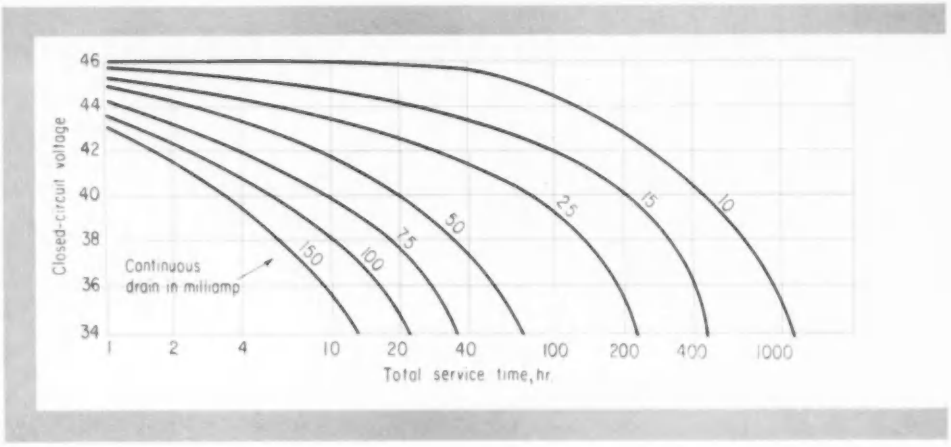
For example, storage for 3 mo. at 113 F reduces life up to 30%; service at 130 F for any time may cause erratic battery operation and sudden failure. Temperatures of 70 F for one yr or 115 F for several mo will not reduce capacity below rated. Below 0 F, indefinite storage will not reduce performance appreciably if the battery is protected from condensation during warmup period. Special mixes and battery types are available to meet most requirements, including operation at −40 F.

WAFER CELLS SAVE SPACE

A strong, nonconducting plastic envelope, a conducting terminal wax, and thinner electrodes have improved the wafer-type Leclanche cell. The plastic envelope holds moisture, yet allows gases to escape. The positive terminal is a sheet of thin, flexible, nonporous plastic heavily loaded with graphite to make it conduc-



Space-saving . . .
wafer dry cell is made of the same Laclanche ingredients that energize its cousin, the common flashlight battery. But power and life are 30% improved by economy of materials and space.



Light-duty service . . .
even though continuous, allows much greater life for battery. Total useful energy for this 45-volt wafer cell "B" battery of 4.5 cu in is 12 amp-hr at 10 milliamp compared with only 2.2 amp-hr at 100 milliamp.

tive. Space-saving over pure carbon plates reduces cell volume; nearly all the volume is occupied now by chemically active ingredients. Connections to the electrodes are made with small smears of conductive silver wax applied over holes cut in the plastic envelope.

When cells are stacked, good contact is made by the wax, which is prevented from spreading by a protective ridge of bitumen surrounding each terminal. High internal resistance limits cell current drain to about 30 milliamp although higher capacities are becoming available. A stack of 200 wafer cells (300 v, 20 cu. in.) operates Geiger counters, potentiometers; 1 to 9 cells (1.5 to 13.5 v) run transistor radios. Wafers are useful where a compact, low-power source is needed.

WATER-ACTIVATED CELLS

More powerful cells are possible using special ingredients that can be kept dry prior to use, eliminating storage problems. Silver or cuprous chloride in conjunction with magnesium provide a cell with a tremendous kick. A single cell, slightly larger than a D-size flashlight battery, produces 100 amp at 1.4 v for a fraction of a min. Others are available from 7.5 to 1000 amp-min at 1.5 v; output can be over 35 amp-min per cu in.

The batteries are energized by filling with water. Some low-voltage cells can operate submerged, while others are wetted until saturated, then operated in air.

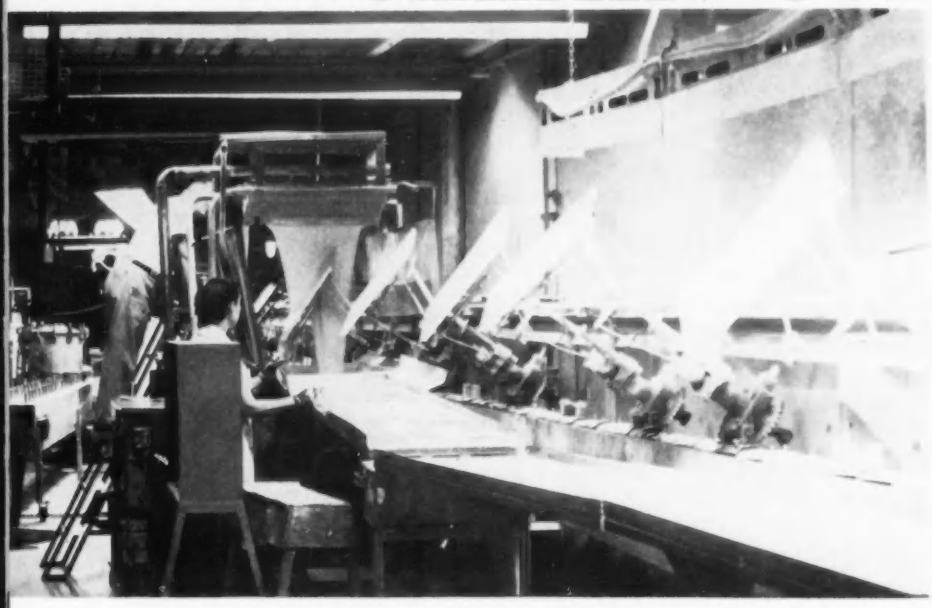
HOW TO PICK

The cost per kw-hr using batteries is several thousand times more than cost of public service power. Battery selection, therefore, is worth thought. Battery makers are usually experts in application, and can help if the following information is provided: actual application; a similar known application; load (amps, volts, cycling, all limits, w-hr total, ohms); space; weight; storage conditions (moisture, elevation, temperature, vibration); terminals; and life expected.

EDITOR'S NOTE: Here are some applications previously discussed: "Watch Runs Without Winding" for Hamilton Watch Co., Apr '57, p 156; and "Battery-operated Timing Motor Uses Clock Movement," Dec '56, p 217.

lower firing temperatures
cut cost for . . .

PORCELAIN COATINGS ON STEEL



Flowcoat method
covers electric range panels
with porcelain enamel

New enamels and better process control now permit one-coat porcelain for ordinary cold-rolled steel. Here's why . . . with some basic facts on porcelain coating to simplify design.

L. E. FUSSELL and H. P. TRIPP
Ceramic Engineers, General Electric Co.
Appliance Park, Louisville, Ky.

To coat a part with porcelain, the firing temperature used to be between 1400 and 1600 F. Today it's often between 1000 and 1200 F. That profitable drop in temperature is one result of recent advances in formulating porcelain enamels. Now, many parts originally designed for organic coatings can be porcelain enameled.

The reduced firing temperatures give a three-way saving in coating costs:

- Ordinary cold-rolled steel can be used because less iron oxide is formed that has to be covered or absorbed by the enamel.
- Thinner-gage steel is permissible because temperature distortion is reduced. Besides being cheaper as a material, lighter gages are easier to work and special bracing is no longer required.
- Furnace operation and tooling costs are lower.

Single-coat porcelain enameling in place of double coating is another manufacturing trend. It adds to the economy of the low-temperature enamels, and results from improvements in surface preparation and process control during firing. Nonpremium steels can now be coated directly—without a prime coat.

The single coatings are as good as those fired over a ground coat as far as color, chemical durability, weather resistance, and abrasion resistance are concerned. And they offer certain practical advantages, including:

- Thinner coatings resist chipping better.
- They are more uniform, particularly around holes, in corners, along edges—places that usually require secondary touchup.
- Cost is reduced by eliminating the ground coat.
- Production can be increased without additional processing equipment.

One-coat enameling can be done at either conventional or low temperatures. Trend in the next five years will be toward low-temperature firing because of the cost advantage. However, multiple-coating techniques are standardized and will continue to be used for some time. This calls for familiarity with enameling

principles common to both methods, and particularly with the advantages to be gained from lower firing temperatures.

HOW COATING IS FORMED

Porcelain enamel glasses, called frits, are complex borosilicates similar to ordinary chemical glassware. For coating, they are modified by oxides. These give color, opacity, adhesion, and make the thermal coefficient of coating match that of the base metal. The frits are prepared as water suspensions called "slips." They are applied to the metal, then dried and fused to the metal at temperatures above 900 F.

Fired surfaces are nonabsorbent, glass-hard, and easily cleaned because of smoothness and abrasion resistance. Colored coatings are fast—unaffected by infrared or ultraviolet light, or temperatures of several hundred degrees. The good match in thermal coefficients means porcelain-coated steel can take temperatures between −20 and 600 F without damage.

Ground coats contain adherence-promoting oxides that impart a blue-black color—a limiting factor in many applications. By adding coloring oxides, ground coats can be produced in dark shades of brown, blue, and green, as well as black. Optimum thickness varies from 2 to 4 mils.

Cover coats are required with light-colored or white enamels, and contain titanium oxides for opacity—these give maximum hiding power with least thickness. For bright-colored enamels, coloring oxides are added to the clear frits. Thicknesses from 3 to 6 mils are common with cover coats. Properties of white titanium cover coats and ground coats are compared, below, for conventional firing temperatures and the two low-temperature ranges.

At conventional enameling temperatures (1400-1600 F), steel sheet undergoes a metallurgical transformation and a volume change which can promote permanent distortion. Also, strength drops enough to allow plastic deformation. Base metal distortion is the major design consideration, and often requires heavier gage steel than is used for parts with organic finishes. Bracing is also commonly needed. For minimum distortion, a special low-carbon, low-metalloid "enameling iron" is recommended. All these precautions add to cost.

With firing temperature lowered to the 1200-1400 F range, gas evolution is still a problem with some steels, but there is less iron oxide to be covered or absorbed by the coating. Good adherence at the edges and on sharp radii is also difficult to obtain. At 1000-1200 F, still less oxide is formed, and sheared edges can be covered with sound coating.

COATING THE PART

Four basic methods are used to apply the porcelain slip to the fabricated steel part, and each should be considered early in design. All four can be used for ground coat or cover coat, but require closer control on cover coating for reasons of appearance.

• **Dipping** can be by hand or machine. Easy accessibility for the slip is a must, and pockets which might collect the coating should be avoided. Simple drain holes, strategically located, ordinarily suffice. This process usually allows the greatest complexity in shape.

• **Spraying**, using air atomization, may also be by hand or automatic. Its greatest use is where drain lines

FIRING TEMPERATURE AFFECTS COATING PROPERTIES

Property	Conventional Temperatures, 1400–1600 F		Low Temperatures			
			1200–1400 F		1000–1200 F	
	Ground Coat	Cover Coat[1]	Ground Coat	Cover Coat	Ground Coat	Cover Coat
Coating wt (one side), gm/sq ft	13–18	18–25	13–23[2]	18–35[2]	13–23[2]	18–35[2]
Gage thickness for identical application	20	20	20–22	20–22	22	22
Acid resistance, PEI rating[3]	B-D[4]	AA-B	B-D	A-C	B-D	AA-D
Alkali resistance, loss mg/sq ft boiling 5% NaOH boiling 5% $Na_4P_2O_7$	 25 1	 10 2	 20 1	 9 14	 30 80	 33 80
Maximum reflectance, %	Low	85	Low	85	Low	70–75
Abrasion resistance, % glass retained (PEI)	48	61	48	58	15	16
Surface texture	Glassy to semi-matte	Smooth, glassy	Glassy to matte	Smooth, glassy	Resembles paint	Resembles paint
Steels used	Enameling iron, some cold-rolled		Cold-rolled, some enameling iron		Cold-rolled	

[1] White titanium base
[2] Heavier wt required for lead-bearing enamels
[3] See "Manual for Porcelain Enamel," PEI, Washington, D. C.
[4] Special enamels available for extreme chemical service

would spoil appearance or interfere with function. Flat surfaces are most easily adapted to automatic processing, and areas not to be enameled are either masked or brushed clean after the enamel has dried. Reject rates rise with added complexity; however, exterior surfaces of such parts are readily handled by experienced sprayers. Interior surfaces must be designed for easy access of gun and hoses. Coverage problems are increased by flanges, brackets and bosses.

• **Electrostatic spraying** is entirely automatic. A large voltage differential attracts mechanically atomized enamel to the part. Many of the coverage problems encountered in plating occur here too. Any place where the electrostatic field concentrates, as on edges and projections, will tend to receive a heavy coating, and embossments will often be hard to cover uniformly. Large flat surfaces are easily and economically coated.

• **Flowcoating** flushes the part with slip and allows it to drain off. Design requirements are like those for dipping, and the process can be hand or automatic. If many different complex shapes are to be flowcoated simultaneously, close cooperation between manufacturing and design will keep the process in balance.

GUIDE TO DESIGN

Design limits of two-coat enamel systems have been studied in some detail, but for one-coat enamels the limitations are not yet precisely known. Until further experience is gained, the following principles based on two-coat technique can be used as a guide for both:

• Radius of curvature should be greater than $\frac{3}{16}$ in. to prevent burn-off of ground or cover coats during firing. Limited experience to date on single-coated parts indicates min radius of $\frac{9}{64}$ in. is reasonable.

• Embossments can be used on large flat areas to add rigidity, counteract warping, prevent "oil can" effects. These embossments should be symmetrical with the outline of the part.

• Flanges for keeping the part straight and flat should have a min depth of $\frac{3}{8}$ in. Where the flange contains holes, depth should be at least $\frac{1}{4}$ in. Welding flanges together at corners gives greater rigidity.

• Brazed steel parts cannot be enameled because the coating will not form a bond with brazing alloys. Welded joints should be free from contaminants like cutting oil—which decompose during firing and cause the enamel to blister.

• The finishing on fabricated steel parts prior to enameling should be kept to a minimum, since abrasives can leave a scratch pattern visible through the fired coating. Also, some abrasives—silicon carbide, for example—may become embedded in the steel and decompose during firing, causing blisters.

EDITOR'S NOTE: Other recent articles on coatings for steel parts include:

"High-temperature Coatings," Jan 20 '58, p 61, discusses the basic factors influencing choice of coatings for high-temperature resistance to corrosion and erosion.

"Pre-painted Steel," Dec 9 '57, p 99, is a full-color Special Report showing how to specify this colorful, functional and economical material.

"Plated Finishes—the Choice Widens," Oct 28 '57, p 81, compares 16 different electroplated finishes for steel parts.

"Hot-dipped Aluminum Coatings," Oct 28 '57, p 57, shows how to substitute less costly base metals, lower fabricating costs, and reduce maintenance by taking advantage of latest aluminum-dipping techniques.

"Ti-clad Steel," Sept 16 '57, p 111, is a progress report on adapting a new material to an old technique.

COATING DEFECTS AND HOW TO CURE THEM

Defect	Description	Cause	Cure
Crazing	Fine cracks in the coating	Residual tensile stresses after firing	Redesign to decrease stresses Change cover-coat enamel
Hairlines	Fine black lines showing through cover coat—result of fractures in this coating during firing	Differential heating Extremely high stresses in metal Unwelded over-lapping parts	Avoid double thicknesses Redesign internal radii Spot weld at closer intervals
Oil can	Bulging in flat section during firing	Loose metal in flat area	Symmetrical embossing
Spalling on radii	Spontaneous chippage on radii	Stresses induced in the enamel by a sharp radius	Min radius of 3/16 in. for two-coat system; 9/64 in. for one coat
Star marks	Fine black lines, in fired cover coat, radiating from a point	Inpact with a sharp object prior to firing Cold point on fixtures	More care in handling Provide better hanging
Warpage	Deformation of metal during firing	Inadequate strength at firing temp.	Heavier gage, lower firing temps., wide flanges, better bracing, embossments

PROPERTIES OF COVER-COAT SYSTEMS

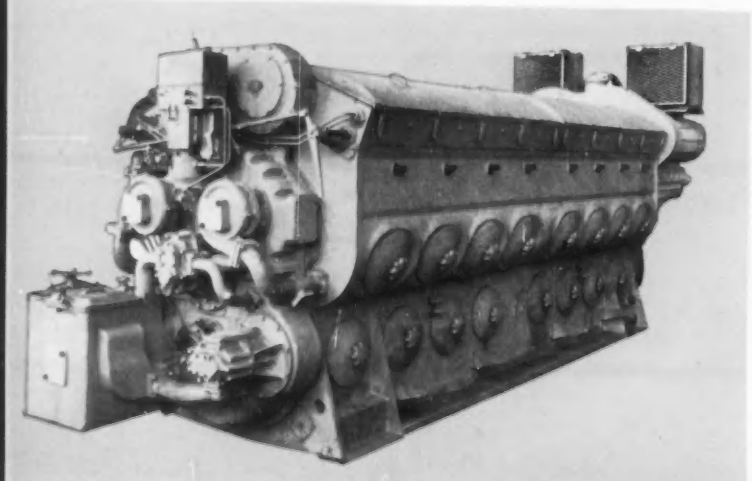
	Two Coats	One Coat
Application weights, gm/ft²	43–60	25–45
Total thickness, mils	6–10	4–6
Torsion resistance, degrees, (PEI rating)	80–90	150–300
Process control required	Moderate	Close

DESIGN FEATURES

Diesels Designed for

Old diesel-electric locomotives don't die at this General Motors plant. They are converted to look and perform like new ones—at 20% less cost —see cover. Designing for interchangeability of major parts is the trick. Overhaul reworks 13 components of old model for reuse.

After rejuvenation into a modern GP-9 locomotive at GM's Electromotive Div., La Grange, Ill., reborn model pulls previous tonnage at 37% higher speed, or 1/3 more tonnage at same speed. First Electromotive mainline freight hauler was model FT, built 1941-45, with a 1350-hp engine. Four other models have been developed since then, each more powerful than its predecessor. Rebuilding comes after two maintenance cycles of six years each.

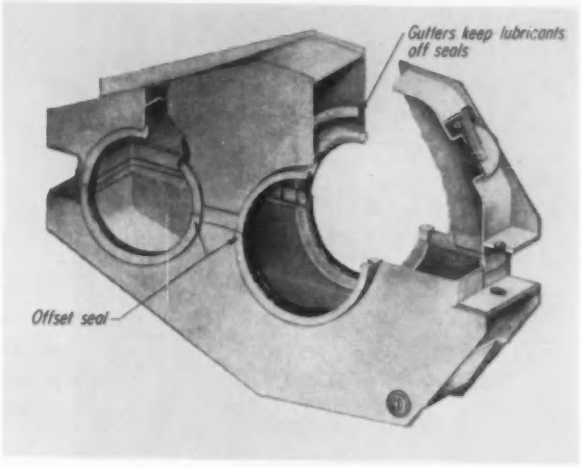


Engine is third model developed . . .
since original design went in FT locomotive and is first major component installed with reworked parts. These parts are the camshafts, crankshaft, blowers, oil pumps, and water pumps. Increased horsepower comes from higher-capacity fuel injector and higher engine rpm. Other engine improvements include external cooling-water inlet-manifolds that eliminate contact between water and the cylinder liner supports and replaceable wear rings for the lower liner pilot bores.

REBIRTH

Modern Locomotive is Result . . .
of economical conversion that beefs up old model (left) with a 1750-hp engine. Total job includes replacing housing, frame, cabling, controls, trucks, engine and generators with new or reworked assemblies. It starts with completely disassembling old model. Parts for reuse are cleaned and reworked to incorporate required design improvements. Remainder is scrapped.

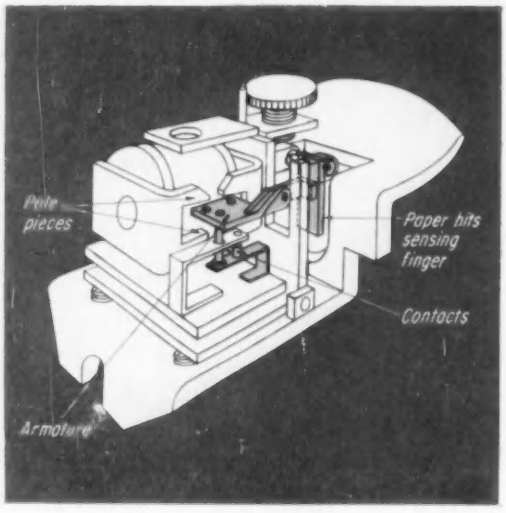
Reworked components are fed to same assembly line that handles new locomotives. Frame and auxiliary equipment mounted beneath it are all new. So is main generator. Control cabinet and controls, shown in assembly on the front cover, are new except for reworked reversing switch and voltage regulator. Belt-driven traction-motor blowers are replaced by units with individual electric-motor drives.



Gear case . . .
for traction motor has offset seal design that extends period between lubricant changes. Lower half is offset outward a distance equal to half the seal width; it purges case of excess lubricant, then holds level uniform. Test gear cases have run over a year in heavy-duty service, without servicing. Unless seals are damaged, case retains lubricant 10 times longer than previous design.

Truck assemblies . . .
are major components reused. They are modified with modern gear cases, brake rigging, triple coil springs, sander guides and traction motors. Motor armatures are rebuilt with fiberglass insulation bonded with silicone resin; field insulation is silicone rubber. Air baffles are redesigned to increase capacity 30% with no change in physical dimensions.

Interlock Monitors Paper Register



This electrical sensing system stops the printing press automatically whenever a sheet of incoming paper isn't fed in far enough for correct registry.

Correctly fed sheet . . .

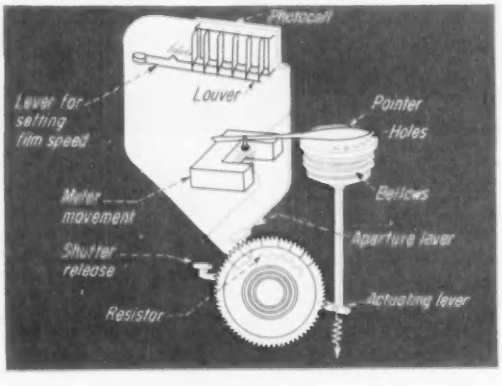
hits sensing finger and raises armature above centerline of space between poles. When coil is energized at end of feed cycle, armature is pulled to upper pole of electromagnet and interlock contacts remain closed. If a sheet feeds short, armature is pulled to lower pole, opening contacts to operate alarm and stop press. Developed by AB Inventing Co., Stockholm, Sweden, device gives register accurate within 0.007 in.

Bellows Controls Camera Exposure

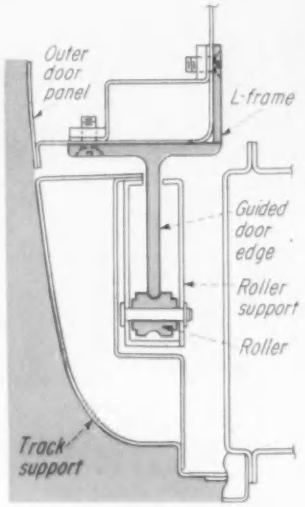
Air flowing through holes in a bellows dashpot sets exposure time in an automatic camera. The pointer of a meter movement energized by a photocell controls flow rate by covering more holes to increase exposure time.

Exposure time . . .

is automatically controlled, after aperture is set for desired depth of focus, and louvers on photocell are set for film speed. Shunt resistance across meter element, adjusted by aperture lever, compensates for lens stop. When shutter is released, the spring-loaded actuating lever moves down against restraint of dashpot. Increasing the number of holes covered increases the exposure time; with all holes open, shutter speed is 1/250 sec; all holes covered, 1/15 sec. Design is by Agfa Camera Works, Munich, Germany.



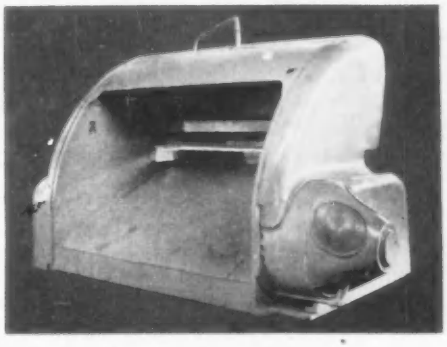
Closed door is supported by L-shaped frame resting on sill and by conical plungers on front hinges. Plungers nest in rubber buffers built into door's front edge. When door opens, L-frame swings out to engage track; rollers in track guide door's lower edge. Upper edge has its own built-in track and is guided by roller on a shaft that slides axially to accommodate door's swing.



Car Door Slides Back

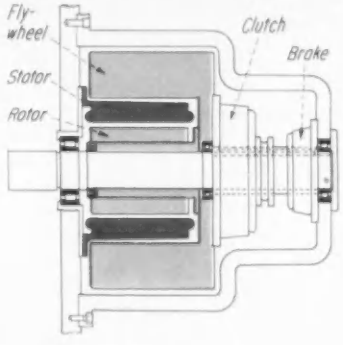
Designed for tight parking places, this door swings out to an external track, then slides back outside the car. It was designed by Pinin Farina for use on the custom-made Alfa Romeo Sestrieres.

Flywheel Houses Motor



Flywheel integral with rotor encloses stator of this Italian motor designed for a guillotine shear. Drive is compact and avoids slippage losses of belt-driven flywheels when shear bites into work.

The integrated drive was designed by Albino Ferranti, Milan, to operate a guillotine shear. Along with increased efficiency, installed cost is lower because fewer bearings and supports are needed.



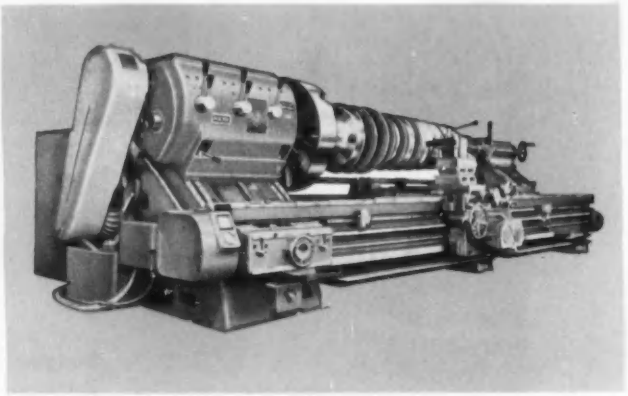
Built-in disk clutch . . . connects rotor and flywheel to concentric drive shaft to operate shear. Brake brings shear to a stop when clutch is disengaged. Elimination of belt slippage, when shear bites into work, increases efficiency of this drive by 10 to 15%. Compactness of drive improves appearance of shear; enclosed design improves safety.

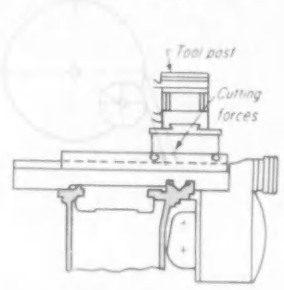
IN FOREIGN MACHINE TOOLS . . .

Austrians Vary Center Height

Headstock and tailstock of universal lathe slide up and back to increase center height, yet keep resultant cutting force inside the front ways.

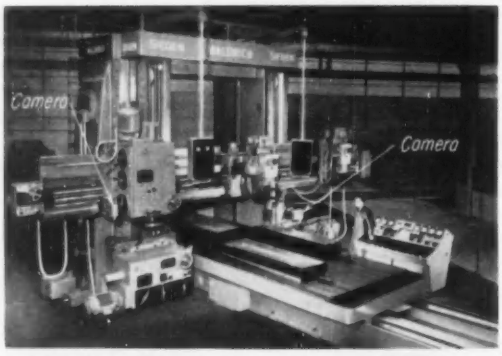
Called Neomat, lathe was designed by Maschinenfabrik Heid AG., Vienna. Data given here are based on description and sketches published in *Progressus*, April, 1957.





Center height is adjustable . . .
from 16 to 22 in. over entire turning length, not just in front of face plate as with gap lathes. Headstock is moved by an electric motor, tailstock with a handwheel. Adjustment takes 3 to 5 min. Fixed stops give accurate alignment at top and bottom positions. In-between settings are made to 0.002 in. with vernier scales.

Germans Put TV in Console

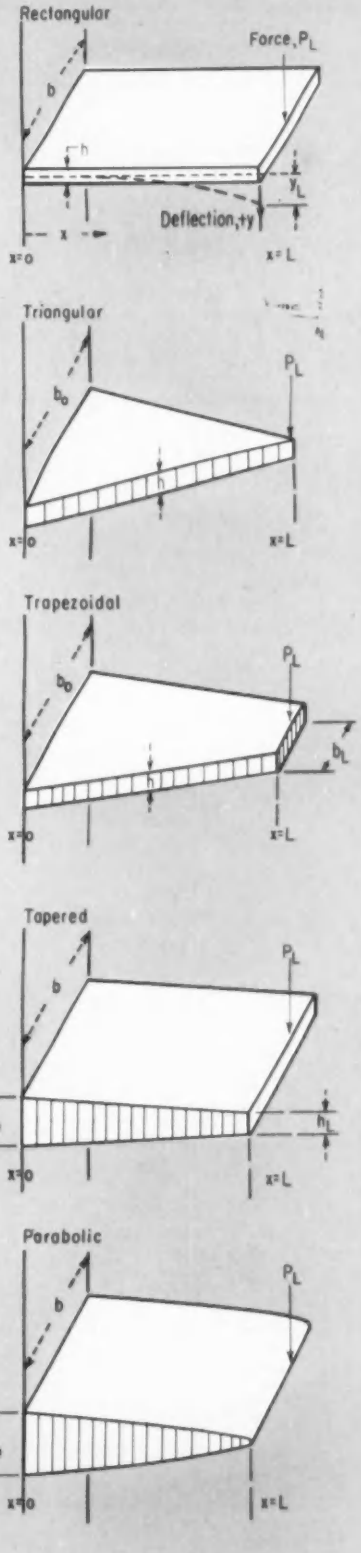


Planer mill has TV cameras that project images of table and head positions on screen in central control console.

The machine designed by H. A. Waldrich GmbH., Siegen., has remote controls and a vernier scale for positioning within 0.0008 in.

Tool action is observed . . .
by a remote-controlled, slewable camera. The scale-reading cameras allow the mill to be operated from sound-insulated control room. Electronic reversing controls are independent of table speed and prevent overtravel. Limits are set at remote console.

5 Types of CANTILEVER BEAMS



for spring action . . .

WHICH CANTILEVER BEAM is BEST?

The rectangular type has most rigidity. But which type has highest volume efficiency? And why is tapering the cross-section so helpful? Here's a first look at working equations derived to help you choose among four variable-section types.

DR. KARL MAIER
Manager, Analytical Research Dept.
Winchester-Western Div.
Olin-Mathieson Chemical Corp.

When comparing cantilever beams, there is more than meets the eye. The most common type is rectangular. But when the beam is considered as a flexible spring rather than as a rigid member, the principles of spring design enter the picture. And now cantilever beams with variable section show superior properties—with the tapered type best as a spring and energy-storing unit.

Infinite variations in shape and size are possible. But most variable-section beams can be assumed to approximate one of four types: triangular, trapezoidal, parabolic, tapered. The set of equations shown on the following page, derived specially for this article, cover these four and also the rectangular for comparison purposes.

First column of the table establishes equations for the general case—a beam whose cross-section may vary in any way. The beam is loaded by a perpendicular force. These equations serve as basis for deriving the five specific cases and also are the starting point for derivation of any other type that might be desired.

The equations are listed in sequence of derivation and are subdivided into four groups covering:

Distribution properties—distribution along the beam length of such factors as cross-sectional area, moment of inertia, bending moment, slope deflection and stress.

Boundary properties, such as deflection and slope of the free end, stress at the fixed end, maximum stress.

Spring properties, such as force-deflection, force-stress and stress-deflection spring rates.

Energy properties, such as elastic energy and volume efficiency.

All of the distribution and boundary properties are employed in design

(continued on page 86)

TABLE I FORMULAS FOR CANTILEVER

	BEAM PROPERTIES	SYMBOL	UNITS	1 GENERAL FORMULAS	2 RECTANGULAR BEAM	3 TRIANGULAR BEAM	
DISTRIBUTION PROPERTIES	Cross-sectional area	A	in^2	A	bh	$b_0 h\left(1-\frac{x}{L}\right)$	
	Moment of inertia	I	$in.^4$	I	$I=\frac{1}{12}bh^3$	$\frac{1}{12}b_0h^3\left(1-\frac{x}{L}\right)$	
	Bending moment	M	in.-lb	$M=P_L(L-x)$	$P_L(L-x)$	$P_L(L-x)$	
	Second derivative of elastic curve	y''	$in.^{-1}$	$y''=\frac{M}{EI}$	$\frac{12P_L(L-x)}{Ebh^3}$	$\frac{12P_LL}{Eb_0h^3}$	
	Slope	y'	in./in.	$y'=\int_0^x y''dx$	$\frac{12P_L}{Ebh^3}\left(Lx-\frac{x^2}{2}\right)$	$\frac{12P_LL}{Eb_0h^3}x$	
	Elastic curve	y	in.	$y=\int_0^x y'dx$	$\frac{6P_L}{Ebh^3}\left(Lx^2-\frac{x^3}{3}\right)$	$\frac{6P_LL}{Eb_0h^3}x^2$	
	Stress	S	psi	$\frac{Mh}{2I}=\frac{E}{2}y''h$	$\frac{6P_L(L-x)}{bh^2}$	$\frac{6P_LL}{b_0h^2}=$ const.	
BOUNDARY PROPERTIES	Deflection at free end	y_L	in.	$y_L=y$ at $x=L$	$\frac{4P_LL^3}{Ebh^3}$	$\frac{6P_LL^3}{Eb_0h^3}$	
	Slope at free end	y_L'	in./in. or radian	$y_L'=y'$ at $x=L$	$\frac{6P_LL^2}{Ebh^3}$	$\frac{12P_LL^2}{Eb_0h^3}$	
	Stress at base	S_0	psi	$S_0=\frac{P_LLh_0}{2I}$	$\frac{6LP_L}{bh^2}$	$\frac{6LP_L}{b_0h^2}$	
SPRING PROPERTIES	Force-deflection rate	$\frac{P_L}{y_L}$	$\frac{lb}{in.}$	—	$\frac{Ebh^3}{4L^3}$	$\frac{Eb_0h^3}{6L^3}$	
	Force-stress rate	$\frac{P_L}{S_0}$	$\frac{lb}{psi}$	—	$\frac{bh^2}{6L}$	$\frac{b_0h^2}{6L}$	
	Stress-deflection rate	$\frac{S_0}{y_L}$	$\frac{psi}{in.}$	$\frac{P_L}{y_L}:\frac{P_L}{S_0}$	$\frac{3Eh}{2L^2}$	$\frac{Eh}{L^2}$	
ENERGY PROPERTIES	Elastic energy	W	in.-lb	$W=\frac{1}{2}P_Ly_L=\frac{1}{2}\frac{P_L}{y_L}\left(\frac{y_L}{S_0}\right)^2S_0^2$	$\frac{S_0^2}{18E}bhL$	$\frac{S_0^2}{12E}b_0hL$	
	Volume	V	$in.^3$	$\int_0^L A\,dx$	bhL	$\frac{1}{2}b_0hL$	
	Volume efficiency	$\frac{W}{V}$	$\frac{in.-lb}{in.^3}$	$\frac{W}{V}$	$\frac{S_0^2}{18E}$	$\frac{S_0^2}{6E}$	
	Specific volume efficiency	η	—	$\frac{W}{V}\frac{2E}{S_0^2}$	0.111	0.333	

	4 TRAPEZOIDAL BEAM	5 TAPERED BEAM	6 PARABOLIC BEAM
	$b_0 h\left(1-k\frac{x}{L}\right)$	$bh_0\left(1-k\frac{x}{L}\right)$	$bh_0\sqrt{1-\frac{x}{L}}$
	$\frac{1}{12}b_0h^3\left(1-k\frac{x}{L}\right)$	$\frac{1}{12}bh_0^3\left(1-k\frac{x}{L}\right)^3$	$\frac{1}{12}bh_0^3\left(1-\frac{x}{L}\right)^{3/2}$
	$P_L(L-x)$	$P_L(L-x)$	$P_L(L-x)$
	$\frac{12P_L(L-x)}{Eb_0h^3\left(1-k\frac{x}{L}\right)}$	$\frac{12P_L(L-x)}{Ebh_0^3\left(1-k\frac{x}{L}\right)^3}$	$\frac{12P_LL}{Ebh_0^3\left(1-\frac{x}{L}\right)^{1/2}}$
	$\frac{12P_L}{Eb_0h^3k}\left[Lx+L^2\frac{1-k}{k}\ln\left(1-k\frac{x}{L}\right)\right]$	$\frac{6P_L\left[2Lx-(1+k)x^2\right]}{Ebh_0^3\left(1-k\frac{x}{L}\right)^2}$	$\frac{24P_LL^2}{Ebh_0^3}\left[-\sqrt{1-\frac{x}{L}}+1\right]$
	$\frac{6P_L}{Eb_0hk}\left[Lx^2-\frac{2(1-k)}{k^2}L^3D\right]$ where $D=\left(1-\frac{kx}{L}\right)\ln\left(1-\frac{kx}{L}\right)+\frac{kx}{L}$	$\frac{6P_L}{Ebh_0^3}\left[\frac{Lx^2-\frac{k^2}{k^2}x}{1-k\frac{x}{L}}-\frac{2L^3}{k^3}\ln\left(1-\frac{kx}{L}\right)-\frac{L^2}{k^2}x\right]$	$\frac{24P_LL^2}{Ebh_0^3}\left[\frac{2L}{3}\left(1-\frac{x}{L}\right)^{3/2}+x-\frac{2L}{3}\right]$
	$\frac{6P_L(L-x)}{b_0h^2\left(1-k\frac{x}{L}\right)}$	$\frac{6P_L(L-x)}{bh_0^2\left(1-k\frac{x}{L}\right)^2}$	$\frac{6P_LL}{bh_0^2}=\text{const.}$
	$\frac{4P_L L^3}{Eb_0h^3}B$ where $B=\frac{3}{2k}\left[1-\frac{2(1-k)}{k^2}\left\{(1-k)\ln(1-k)+k\right\}\right]$	$\frac{4P_L L^3}{Ebh_0^3}H$ where $H=\frac{-(3+1.5k)}{k^2}-\frac{3}{k^3}\ln(1-k)$	$y_L=\frac{8P_L L^3}{Ebh_0^3}$
	$\frac{12P_L L^2}{Eb_0h^3k}\left[1+\frac{1-k}{k}\ln(1-k)\right]$	$\frac{6P_L L^2}{Ebh_0^3}\frac{1}{1-k}$	$y_L=\frac{24P_L L^2}{Ebh_0^3}$
	$\frac{6LP_L}{b_0h^2}$	$\frac{6LP_L}{bh_0^2}$ Max. stress for $k\leq\frac{1}{2}$	$\frac{6LP_L}{bh_0^2}$
	$\frac{Eb_0h^3}{4L^3B}$	$\frac{Ebh_0^3}{4L^3H}$	$\frac{Ebh_0^3}{8L^3}$
	$\frac{b_0h^2}{6L}$	$\frac{bh_0^2}{6L}$ $\left(k\leq\frac{1}{2}\right)$	$\frac{bh_0^2}{6L}$
	$\frac{3Eh}{2L^2B}$	$\frac{3Eh_0}{2L^2H}$ $\left(k\leq\frac{1}{2}\right)$	$\frac{3Eh_0}{4L^2}$
	$\frac{S_0^2b_0hLB}{18E}$	$\frac{S_0^2bh_0LH}{18E}$ $\left(k\leq\frac{1}{2}\right)$	$\frac{S_0^2bh_0L}{9E}$
	$b_0hL\left(1-\frac{k}{2}\right)$	$bh_0L\left(1-\frac{k}{2}\right)$	$\frac{2}{3}bh_0L$
	$\frac{S_0^2B}{18E\left(1-\frac{k}{2}\right)}$	$\frac{S_0^2H}{18E\left(1-\frac{k}{2}\right)}$ $\left(k\leq\frac{1}{2}\right)$	$\frac{S_0^2}{6E}$
	$\frac{B}{9\left(1-\frac{k}{2}\right)}$ from 0.111 to 0.333	$\frac{H}{9\left(1-\frac{k}{2}\right)}$ from 0.111 to 0.24 $\left(k\leq\frac{1}{2}\right)$	0.333

quite extensively. For example, the deflection and stress equations are necessary for analyzing beam stability and strength. Spring and energy properties are not as well known. They are considered mostly when the beam is to function as a possible energy-storage unit.

SPRING RATES

With cantilever beams, as in any spring design, compromise is needed between contradicting requirements of the spring performance—force, deflection, stress. Analysis can be simplified by considering the relationship of two of these three major values:

Force-deflection rate:

$$P_L/y_L, \text{ lb/in.}$$

Force-stress rate:

$$P_L/S_o, \text{ lb/psi}$$

Stress-deflection rate:

$$S_o/y_L, \text{ psi/in.}$$

They are not independent, but connected by the identity relation:

$$P_L/y_L = (P_L/S_O)(S_O/y_L)$$

Subscript 0 in above equation refers to fixed end of beam, subscript L to loaded end. The spring rates are listed in Table I in a separate group.

ENERGY AND VOLUME EFFICIENCY

Elastic energy is equal to external work done in deflecting the beam:

$$W = \tfrac{1}{2} P_L y_L$$

To express value of W in terms of max stress, force P_L and deflection y_L are eliminated by introducing the force-deflection rate P_L/y_L and stress-deflection rate S_o/y_L, which are direct functions of the beam dimensions and modulus of elasticity:

$$W = \tfrac{1}{2}(P_L/y_L)y_L^2 = \tfrac{1}{2}(P_L/y_L)(y_L/S_O)^2 S_O^2$$

Efficiency with which the beam stores energy can be determined by comparing the stored elastic energy with the volume of material storing this energy. The volume efficiency is then defined as the ratio W/V.

Because a rod under tension has about the highest volume efficiency in storing energy, the efficiency of the beam in bending is compared with that of the tension rod. This gives the "specific volume efficiency"

$$\eta = \frac{2EW}{S_O^2 V}$$

Since it gages how efficiently space and weight are being used, it serves as a quality index for a beam.

Rectangular Beams

The most common type of cantilever beam has a constant width and thickness, Column 2 in table. It is often called a rectangular "leaf spring" and gives basis for comparison with the four variable-section beams.

Specific volume efficiency of the rectangular leaf spring is rather poor

$$\eta = 0.111$$

because free-end portion of the beam works at rather low stress and contains considerable dead weight.

Optimum Beams

These distribute stress uniformly over length of the beam. With rectangular cross-section, two types of ideal beams are found: (1) triangular—has constant thickness and triangular profile in the horizontal plane; (2) parabolic—has constant width and parabolic profile in the vertical plane.

Both types, however, are not very practical from the manufacturing standpoint and for them should be substituted trapezoidal and tapered beams—which give a fair approximation of the desired shape.

Triangular Beam

Equations for the triangular beam are given in Column 3 of table. Surface stress is constant over the entire length. Deflection of the free end is 1.5 times that of a rectangular leaf spring of same base b_o and thickness h. Therefore, with the same force P_L and max stress S_o, the triangular beam stores 1.5 times as much elastic energy and, because its volume is only half that of the rectangular beam, its efficiency is triple, or

$$\eta = 0.333$$

This is the max specific volume efficiency obtainable with any type of beam in bending. However, the triangular beam is only an ideal design because a load on the tip leads to infinite contact pressure and shear stresses. A practical beam must have a min width b_L at its free end. This leads to the . . .

Trapezoidal Beam

Degree of tapering here is described in the taper coefficient k:

$$k = (b_O - b_L)/b_O$$

This beam is obviously an intermediate shape between the rectangular leaf spring, $k = 0$, and the triangular spring $k = 1$. Deflection of the trapezoidal is greater than the rectangular beam by the deflection factor B, which is a function of k. Efficiency of the trapezoidal is also a function of k.

$$\eta = \frac{B}{9(1 - k/2)}$$

In practice, k is limited to values of 0.8 or below. This gives sufficient cross-sectional area to the tip of the beam. Referring to Table II, a value of $k = 0.8$ will cause a deflection 31% greater than a corresponding rectangular beam. Specific volume efficiency is 0.24, more than twice that of a rectangular beam.

Parabolic Beam

Surface stress is constant over entire length of the beam. Deflection of the free end is exactly twice that of a rectangular leaf spring of same width, base thickness and exterior force. The parabolic beam stores twice the elastic energy, while its volume is only $\frac{3}{4}$ that of the comparable rectangular beam. Efficiency is therefore

$$\eta = 0.333$$

which is the max efficiency obtainable with any beam.

MAJOR VALUES vs TAPER COEFFICIENT k

TABLE II—TRAPEZOIDAL BEAM

k	0	0.2	0.4	0.4	0.5	0.6	0.8	1.0
Deflection factor B	1	1.054	1.121	1.121	1.160	1.202	1.315	1.50
Efficiency η	0.111	0.130	0.156	0.156	0.172	0.191	0.243	0.333

TABLE III—TAPERED BEAM

k	0	0.2	0.4	0.6	0.8	0.9	1.0	Parabolic
Deflection factor H	1	1.18	1.44	1.89	2.87	4.12	∞	2
Max stress at point x/L	0	0	0	0.33	0.75	0.89	1.0	..
Stress ratio S_{max}/S_o	1	1	1	1.04	1.56	2.78	∞	1
Efficiency η	0.111	0.146	0.200	0.278	0.218	0.108	0	0.333

The anguar deflection or slope of the free end is

$$y_L' = 3(y_L/L) = 4y'_L$$

This is three times the angle of the secant from fixed to deflected end, and four times the slope of the corresponding rectangular beam.

Tapered Beam

It is similar to, but more practical than the parabolic beam. Here k refers to thickness rather than width:

$$k = \frac{h_O - h_L}{h_o}$$

The tapered beam is an intermediate shape between the rectangular leaf spring, $k = 0$, and the ideal parabolic profile. Max stress is not always found at the same point. With taper coefficients less than $\frac{1}{2}$ the fixed end ($x = 0$) carries the max stress:

$$S_{max} = S_O = \frac{6LP_L}{bh_O^2}$$

With larger taper coefficients, in the range $\frac{1}{2}<k<1$, max stress is located at an intermediate point of the beam and is greater than stress at the base. The location can be found from this equation

$$\frac{x}{L} = \frac{2k - 1}{k}$$

Reason for the variance in location of max stress is: For taper coefficients up to $\frac{1}{2}$, longitudinal profile of the tapered beam is outside the parabolic profile. This puts max stress at the fixed end because this cross-section is most critical. With taper coefficients more than $\frac{1}{2}$, contour lines of the tapered beam intersect the parabolic curve, resulting in cross-sections thinner than that of the parabolic, so must carry a stress greater than S_o at the fixed end. This max stress is

$$S_{max} = \frac{6P_LL}{bh_O^2\,4k(1 - k)}$$

Ratio of max stress to base stress S_o is then:

$$S_{max}/S_O = \frac{1}{4k(1 - k)}$$

Deflection of a tapered beam exceeds that of a comparable rectangular beam by the deflection factor H, values for which are compiled in Table III. With k approaching the value 1 (triangular profile in vertical plane), H increases to infinity. For comparison, the parabolic deflection factor is equal to 2.

Efficiency of tapered beams with k less than 0.5 is

$$\eta = \frac{H}{9(1 - k/2)}$$

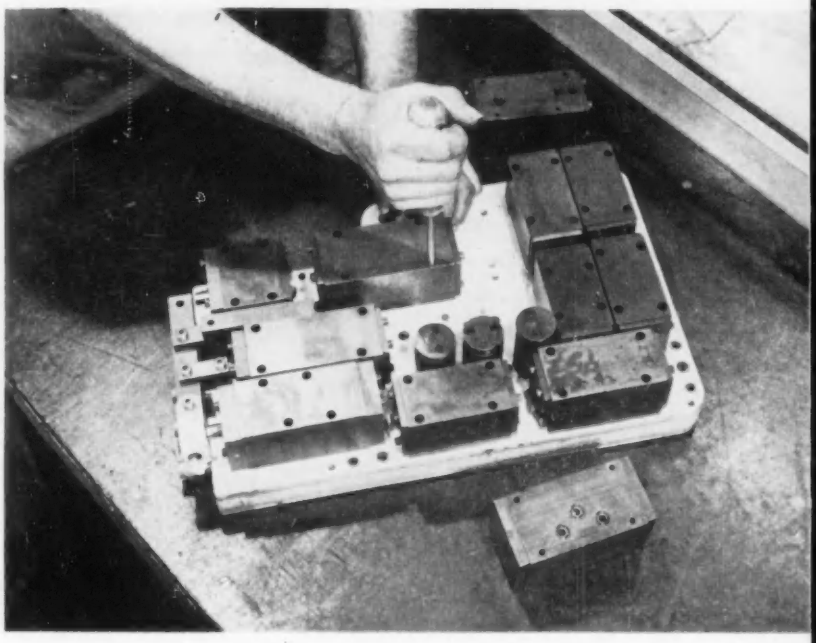
Beams of $k = \frac{1}{2}$ have an efficiency of 0.242 at a deflection factor $H = 1.63$.

By increasing the taper coefficient toward $k = 1$, the point of max stress is shifted from the fixed end (at $k = \frac{1}{2}$) toward the free end (at $k = 1$). This is accompanied by a continuous increase in stress. Comparison with a rectangular beam is no longer possible because a given force not only produces greater deflections, but also higher stresses.

Efficiency increases up to about 0.28 at a k value near 0.6 and then drops to zero when k increases up to 1. Therefore, for best beam design, k should not exceed the value 0.6; thickness at free end should be at least 40% of the thickness at the base. Deflection and energy capacity of such beams is up to 90% greater than those of comparable rectangular springs.

Therefore, the tapered beam is distinctly superior even to the optimum trapezoidal spring and—along with easy manufacture—represents the most efficient beam shape. (Only the parabolic beam is somewhat superior in deflection and volume efficiency.) This is why the tapered beam should be employed whenever max deflection, energy capacity, or volume efficiency are of prime interest.

No tubing needed—passages in manifold connect hydraulic components



when valves
belong together
keep them together
with . . .

SANDWICH MANIFOLDING

If the prototype of a hydraulic circuit design turns out to be a forest of tubing and fittings, almost hiding the hydraulic components, then look to this method for an economical answer.

ALLEN A. DICKE
Monarch Machine Tool Co.
Sidney, Ohio

The curse of automatic hydraulics is the complex of piping and controls it brings into assembly. Here is a proven way to eliminate half the problem—the piping It's done with a sandwich manifold containing a base plate that not only mounts the hydraulic components but also contains the interconnecting passages.

Simplest version of the manifold is an assembly of two plates: the thicker has machined or cored-out passages on one side (resembling a printed-circuit board). The second plate is brazed on top as a cover, and porting holes are drilled into the passages. Tapped holes in the cover permit mounting of valves and other devices.

Or both sides of the thick plate can be machined out and two covers brazed on. This 3-ply method permits mounting components on both sides of the sandwich. Sandwiches beyond 3-ply are also possible, as in the New York subway system, but not common.

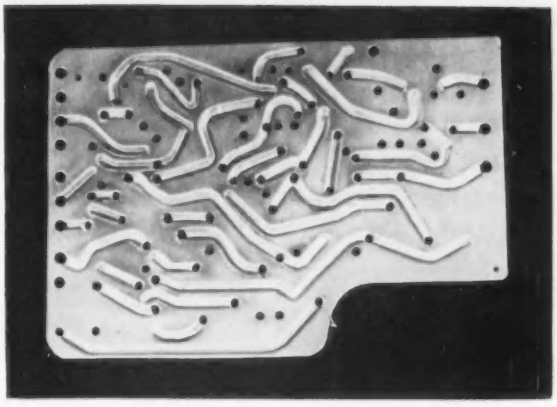
SAVES SPACE AND MONEY

The old way, with tubing, requires large-bend radii, bulky connections, and wrench-room. Sandwich manifolding eliminates tubing fittings, shortens passages and keeps them in one (or two) horizontal planes. Simultaneously it provides a strong mounting surface. Aluminum plates will help keep weight down.

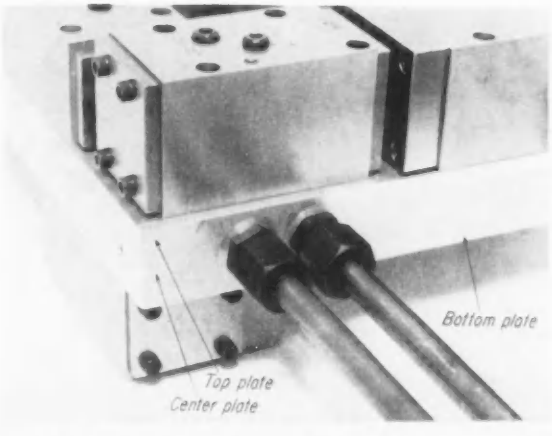
Cost can be less for sandwich manifolding because quantity production is possible. Here the plates can be die-cast rather than machined, giving more accurate and consistent results. Piped components, by contrast, always require considerable labor no matter how many identical assemblies are made; and errors, leaks, unsightly connections, vibration failures can result.

BEST FOR GROUPED COMPONENTS

Manifolding works best with components that are grouped functionally and physically close. Sequencing and safety-interlock circuits are two good examples. It is worthwhile to draw design schematics with this in mind, showing functional boundaries by dotted lines. Interconnections between groups can be designed with tubing, or with porting through the frame or body of the main machine. It is easy to catch errors made in drawings by first checking each complete manifold



Machined grooves . . .
in top and bottom face of center plate of 3-ply manifold serve as hydraulic passages between preselected points. Top face is connected with bottom face by drilled holes where inter-connections are necessary.



grouping, then the interconnections between manifolds.

Components mechanically connected to the machine (such as hydraulic pump driven by a shaft on an accessory gearbox) must be located near edge of the manifold. Passages machined in the center plate should avoid interference and thin walls. Where passage crossing is necessary, both sides of the plate can be grooved, and cross-over accomplished by drilling through. This becomes a 3-ply sandwich.

With 3-ply construction, it is wise to orient the general passage direction on one side north-to-south and on the other east-to-west to assure crossing of passages that will be drilled through. Friction loss in operation will compare favorably with tubing and fittings if total passage length and turns are kept to a minimum.

Manifold shape depends on contour of the machine frame to which it must be mounted. Installation is easy if frame-to-manifold ports are incorporated, because the sandwich assembly can be dropped into position without pipe connections. Sealing is accomplished with O rings.

The draftsman will usually be able to convert from tubing to manifolding without an engineering redesign. There is one important exception: All devices must have inlet and outlet connections on one face, capable of leakproof attachment (using O rings, for example) with this face against the sandwich. To prevent mismounting, different bolting dimensions are selected for each different component.

QUALITY CONTROL REQUIRED

Aluminum plates are favored because of inertness to oil and moisture, ease of manufacture, durability, and general availability. Brazing of aluminum, however, requires excellent equipment and a skillful operator.

Whatever the plate, it must be of high quality to avoid cracks, porosity, warping, and poor brazing characteristics. Brazing should be done carefully to avoid drips into the channels or leaks between channels. Complete operational testing is especially important, at least on a sampling basis, because there is no way to check inside joints visually.

EDITOR'S NOTE: A machine tool application is described in "Sandwich Manifolds Replace Piping," Oct 14 '57, p 84.

For help in making connections to plates, see "How to Apply O-rings," Aug '57, p 176.

Oil supply . . .
and return come into edge of plate. Other porting methods are: at manifold bottom, using O rings, to match similar parts in machine frame; or tube connection brazed on top or bottom of manifold.

1958 DESIGN SHOW APRIL 14 to 17

Design Show Issue . . .

to be published March 31, will include the full program of the 1958 Design Conference and abstracts of the papers, a floor plan of the exhibits, and list of exhibitors classified by product. Also there'll be a new listing of Anson Mcanor's famous "Where to Eat in Chicago."

A special 24-page report, written by staff and contributing editors, will emphasize the new and expanding responsibilities of the engineering profession.

Design Conference Program . . .

scheduled for the forenoon of each day, April 14–17, at the Stockyards Amphitheatre in Chicago, will start with a panel Monday morning on "Putting the Design Into Production," with George Nordenholt, former editor of PRODUCT ENGINEERING, as moderator, and panel members from manufacturing, quality control, purchasing and design-engineering functions.

On Tuesday and Wednesday, three concurrent sessions will be conducted each day covering mechanical, materials, and power and control fields. Chairmen will be: Mechanical, Colin Carmichael, editor of *Machine Design*; Materials, Henry Clauser, editor of *Materials in Design Engineering*; Power and Control, Frank Oliver, editor of *Electrical Manufacturing*. Two papers are planned for each session.

Closing day, Thursday, will be given to a general engineering session with two papers on documentation and cataloging, under chairman William Budington, associate librarian of John Crerar Library in Chicago.

Conference is sponsored by Machine Design Division, The American Society of Mechanical Engineers, 29 West 39th St., New York 17.

Design Engineering Show . . .

scheduled for the afternoon of each day, April 14-17, at the Chicago Amphitheatre. Exhibit hours: noon to 6:00 pm each day. More than 400 companies selling to the original-equipment market will display products and components, and have engineering personnel available to discuss applications of: mechanical components, power-transmission equipment, electrical and electronic parts, metallic and nonmetallic materials, fasteners and adhesives, finishes and coatings, hydraulic and pneumatic components, and engineering services and equipment. Show management: Clapp & Poliak, Inc., 341 Madison Ave., New York 17.

1957 Index . . .

is now ready. Because of our weekly publishing cycle and the increased size of the Index, it was not included in our final issue of 1957. Instead, it has been printed separately, and single copies can now be supplied.

Index is 16 pages, and lists all major "Engineering Week" and "Developments to Watch" subjects, as well as the feature articles and departments in all editions—800 more items than in the 1956 Index. A separate author index is included, and a table of contents for the Design Digest issue.

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of selected feature articles will be included in an expanded reader service starting in the next Design Edition, on March 3. Articles in both R&D and Design editions, selected for their reference content, will be reprinted and single copies made available to readers requesting them by letter or by the Reader Service Card.

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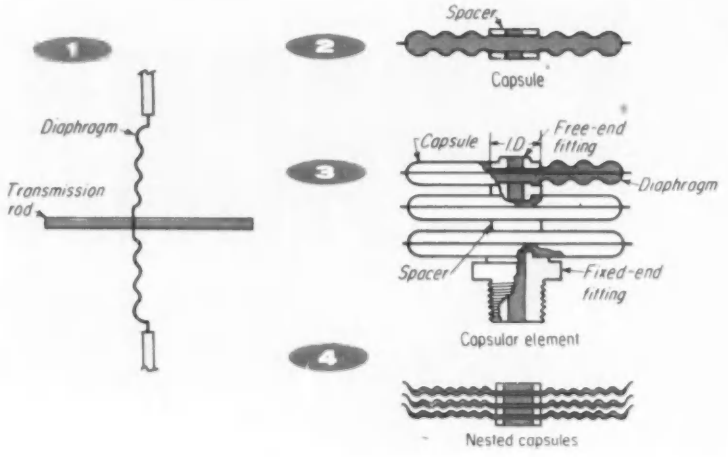
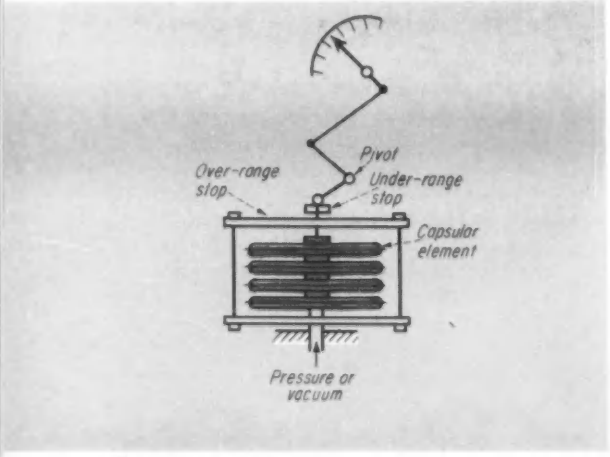
10 ways to use METAL DIAPHRAGMS



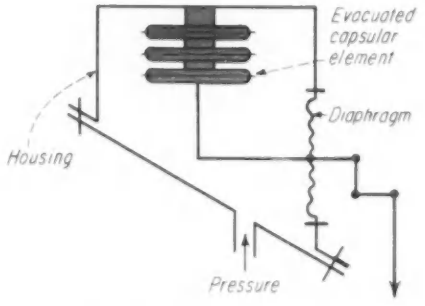
Metal diaphragm . . .
is usually corrugated (1) or formed to some irregular profile. It can be used as a flexible seal for actuating rod. Capsule (2) is an assembly of two diaphragms sealed together at their outer edges, usually by soldering, bronzing or welding. Two or more capsules assembled together are known as a capsular element (3). End fittings for capsules vary according to their function; the "fixed end" is fixed to the equipment. The "free end" moves the related components and linkages. Nested capsule (4) requires less space and can be designed to withstand large external overpressures without damage.

5



Pressure gage . . .
has capsular element linked to dial indicator by three-bar linkage. Such a gage measures pressure or vacuum relative to prevailing atmospheric pressure. If greater angular motion of indicator is required than can be obtained from three-bar linkage, a quadrant and gear can be used.

6



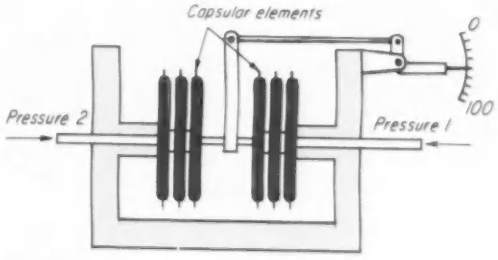
Absolute pressure gage . . .
has an evacuated capsular element inside an enclosure that is connected to pressure source only. Diaphragm allows linkage movement from capsule to pass through sealed chamber. This arrangement can also be used as a differential pressure gage by making a second pressure connection to the interior of the element.

and CAPSULES

Product Engineering

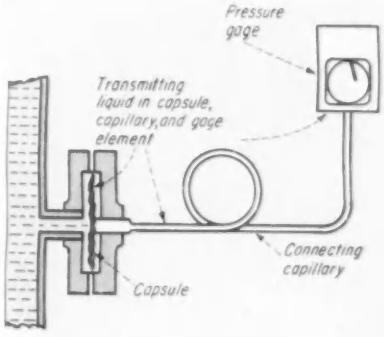
DESIGN ROUNDUP...

D. C. WHITTEN
Development Engineer
Bristol Co., Waterbury, Conn.



7

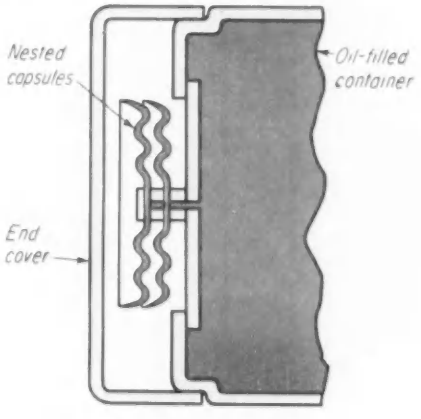
Differential pressure gage . . .
with opposing capsules can have either single or multicapsular elements. The multicapsular type gives greater movement to indicator. Capsules give improved linearity over bellows for such applications of pressure measuring devices. Force exerted by any capsule is equal to the total effective area of the diaphragms (about 40% actual area) multiplied by the pressure exerted on it. Safe pressure is the max pressure that can be applied to a diaphragm before hysteresis or set become objectionable.



8

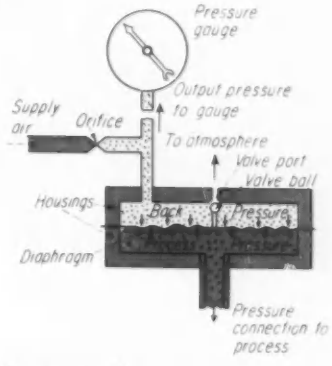
Capsule pressure-seal . . .
works like a thermometer system except that the bulb is replaced by a pressure-sensitive capsule. The capsule system is filled with liquid such as silicone-oil and is self-compensating for ambient and operating temperatures. When subjected to external pressure changes, the capsule expands or contracts until the internal system pressure just balances the external pressure surrounding the capsule.

9



Expansion compensator . . .
for oil-filled systems takes up less space when capsules are nested. In this application, one end of capsule is open and connected to oil in system; other end is sealed. Capsule expansion prevents internal oil pressure from increasing dangerously from thermal expansion. Capsule is protected by end cover.

10



Force-balance seal . . .
solves the problem, as in seal 8, of keeping corrosive, viscous or solids-bearing fluids out of the pressure gage. The air pressure on one side of a diaphragm is controlled so as to exactly balance the other side of the diaphragm. The pressure gage is connected to measure this balancing air pressure. Gage, therefore, reads an air pressure that is always exactly equal to the process pressure.

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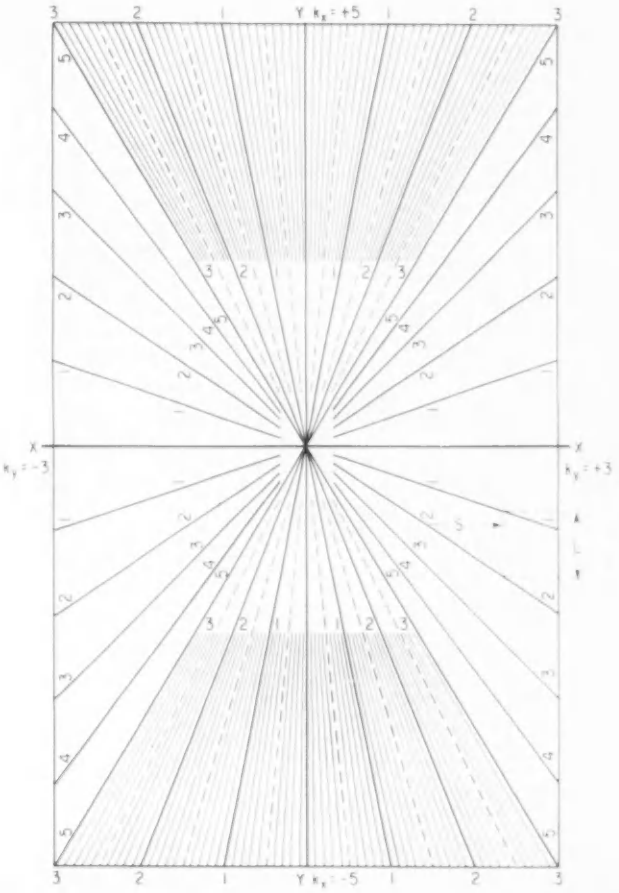
Chart Eases Moment-of-Inertia Calculations

When a section is irregularly shaped, simple calculation of moment of inertia is not possible; the usual method of splitting the shape into many small rectangles involves long calculation. Method based on master chart shown below enables all section properties to be easily found. An example is worked on p 97.

WILLIAM G. FLANNELLY
Stress Engineer
Kaman Aircraft Corp.
Bloomfield, Conn.



Master M-of-I chart . . .

is constructed in any size by bisecting the sides of a rectangle, calibrating them, and projecting radii to the center of the rectangle. The sides can be calibrated in any units (cm, ½ in. to ft, etc.) provided the same units are used in plotting. Similarly the chart may be graduated into more or fewer k units than are shown here. For example, k_x could equal ± 6, and k_y some other figure.

For drafting economy, it might be desirable to plot a very large form on tracing paper and obtain different sizes of smaller forms by cutting out progressively smaller center sections from the prints. The k values remain the same for all sizes.

It is important to establish the correct values for k_x and k_y. If S be the distance from an axis to a parallel line, and L the length of one unit along that line, then $k = S/L$.

(continued on page 97)

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U.S. Molded Train Diaphragm (left) for new "Talgo" and other lightweight trains provides neater, stronger, more flexible covering for joints and couplings. That's why it was selected for these revolutionary trains. To keep up with the modern "look" and performance of this new railroading design, this "U.S." bellows-type diaphragm flattens out or compresses as the train takes curves at speeds never before attained. To do this and still retain its shape and strength, the diaphragm was carefully engineered of cloth-inserted, fire-resistant neoprene rubber, produced to the exact specifications of the customer.

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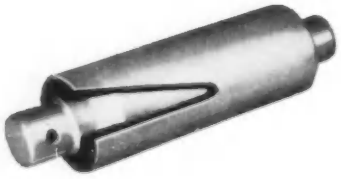
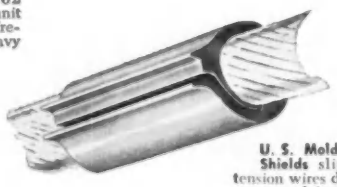


U. S. Molded Oil Pump Bearings eliminate 62 conventional pumping unit parts, and absorb high-frequency vibrations and heavy well shocks.



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U. S. Molded Diaphragms for motor valves regulating the flow of liquid through piping systems. Precise, uniform molding makes them standard equipment of leading motor valve manufacturers.

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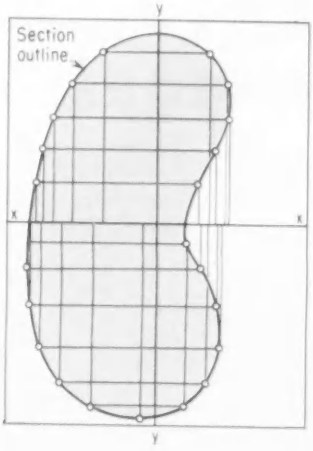
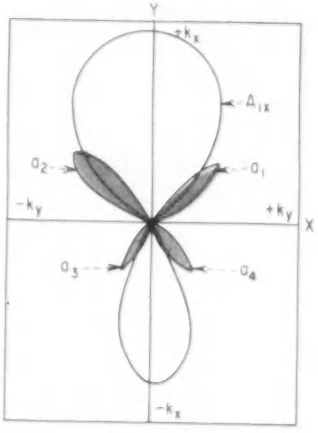
Chart for Inertia Calculations (concluded)



To find moment of inertia . . .

and the location of the center of gravity: Draw section on transparent paper; draw right-angled axes *x*, *y* through section. On the outline choose enough points to reasonably define its shape. From each point draw light perpendicular lines to each axis.



To find the product of inertia . . .

draw the first-moment figure about either axis, say X. Draw light lines through this figure parallel to the Y axis and construct the first-moment curve of this figure about the Y axis. The first moment about the X axis was previously determined. This illustration shows a plot of the first-moment curves of A_{1x} taken about the Y axis.

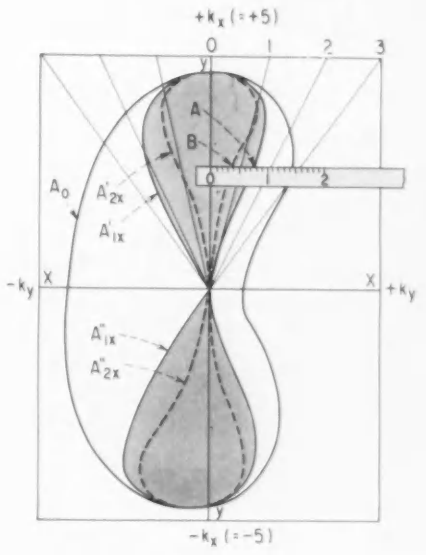
The product of inertia is then

$$U_{xy} = k_x k_y a_1 + (-k_y) k_x a_2 + (-k_y)(-k_x) a_3 + (-k_x) k_y a_4$$

or

$$U_{xy} = k_x k_y (a_1 + a_3 - a_2 - a_4)$$

where a_1, a_2 . . . are areas of the second construction figures. If the values of the product of inertia and the moments of inertia about right-angled axes through a point are known, the angles and values of the principal moments of inertia, about axes through that point, can be found by the usual textbook formulas.



Place section outline . . .

on M of I chart and superimpose the axes. Lay a scale along one of the previously drawn light lines and measure the distance from the Y axis to the section outline. Where the master-chart radius, corresponding by number to the scale-reading, intersects the scale, place a mark. On the scale, read the distance of this mark from the Y axis, and where the radius corresponding to this reading intersects the scale, place another point.

In the above example, a point on the outline of the section is measured at 1.42 in. from the Y axis. Therefore "A" is marked where the 1.42-in. radius intersects the light line. Point "A," in turn, is 0.75 in. from the Y axis. Point "B" is made where the 0.75-in. radius crosses the line.

Repeat this process for every horizontal line and connect resulting sets of marks and points to give curves shown.

With planimeter, find areas enclosed by outer loops (A'_{1x}, A''_{1x}). (Constant k_x is negative for the A_{1x} loop, which is below the X axis). The first moment of the section about the X axis is given by

$$M_{1x} = k_x A'_{1x} - k_x A''_{1x}$$

Find area of original section (A_o). The distance from the X axis to the center of gravity is

$$y = \frac{M_{1x}}{A_o}$$

Find areas enclosed by the inner loops, A'_{2x} and A''_{2x}. The moment of inertia of the section about X axis is given by

$$I_x = k_x^2 (A'_{2x} + A''_{2x})$$

A similar procedure gives properties about the Y axis.

From Century... completely redesigned Performance-Rated© GEARMOTORS

Here they are... new improved Century Gearmotors ... Performance-Rated for exact application of motor to job... embodying that famous *Century dependability!* Available with Century polyphase, single phase and DC motors. Variety of mounting positions possible, including downshaft and tilted shaft.

Improved equipment performance for you with new improved Century Gearmotors

No pinion play, no creep even under reversing service! Motor shaft machined for high speed pinion assembly... pinion splined into shaft and rigidly, positively locked in perfect alignment!

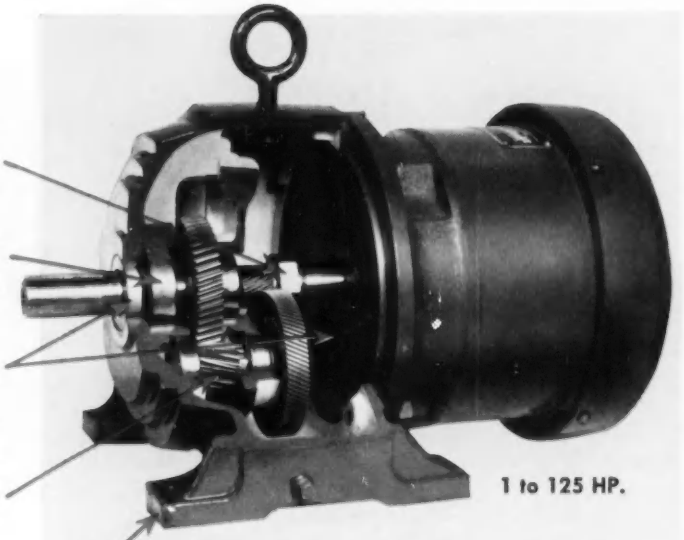
Trouble-free service even under heaviest loads and severest operating conditions is provided by extra-capacity bearings, integral bearing housings.

Cooler operation... maximum wear life, and extra thermal capacity through improved case design and superior oil mist lubrication. Improved oil seals keep the lubricant *in* and foreign matter *out*.

More dependable power transmission... higher capacity and longer wear life with Duti-Rated Lifetime helical gearing. Carefully controlled heat treating processes give file-hard tooth surfaces, tough ductile tooth cores.

Permanently accurate alignment of shafts, gears, bearings and seals assured by extra-rigid, cast gear housing. Alignment can't be distorted by overhung loads, uneven mounting surfaces, impact. Quick easy disassembly for inspection or maintenance without disconnecting from driven equipment.

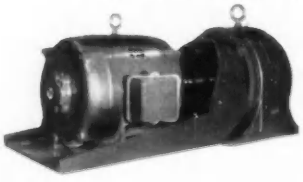
Century Gearmotors are Performance-Rated for precise application to your equipment requirements in the full Century range of motor size, speed, torque, mounting. Available in drip proof, explosion proof or totally enclosed frames.



1 to 125 HP.

Single, double and triple reduction available with output speed 750 to 7.5 RPM.

Century Gearmotor with shelf-type motor base.



Ideal for use on equipment for plants where motors must be interchangeable. Uses Century standard horizontal motor.

Investigate these improved Century Gearmotors now. For further details, call or write your nearby Century District Sales Office or Authorized Distributor.

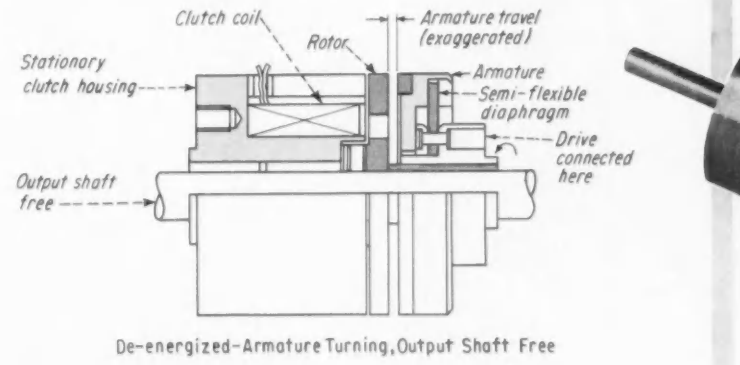
Performance-Rated© MOTORS 1/20 to 400 HP

CENTURY ELECTRIC COMPANY

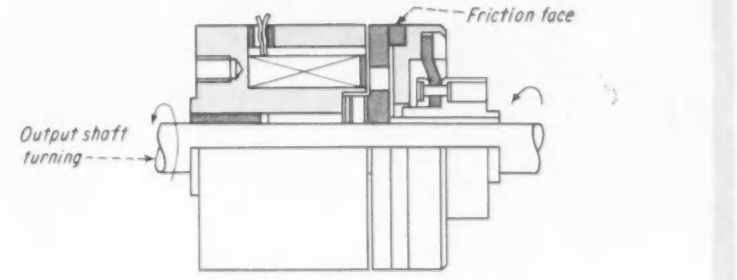
63

1806 Pine Street • St. Louis 3, Missouri • *Offices and Stock Points in Principal Cities*

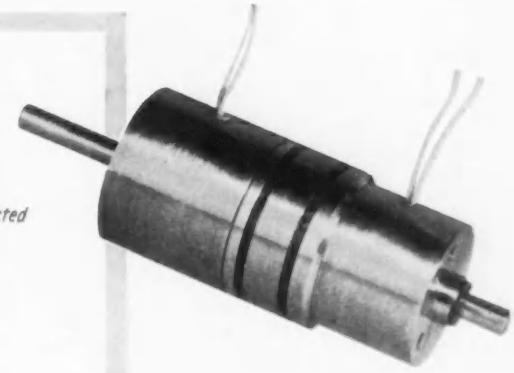
Miniature Clutches, Brakes Have No Brushes



De-energized–Armature Turning, Output Shaft Free



Energized–Input Shaft Coupled to Output Shaft Through Rotor



Directly wired fixed field in this redesigned line of miniature-to-small electric clutches and brakes has stationary housing that eliminates slip ring and brush assemblies. Clutch and coupling units are available separately, clutch and brake as matched assemblies. Application to machine-control systems, remote-control equipment, computers, instrumentation is expected.

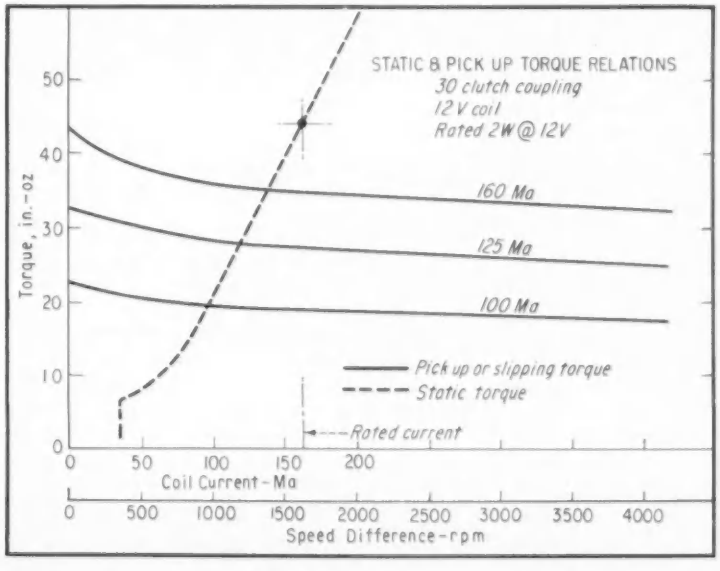
Design is based on a flexible neoprene-and-nylon diaphragm in the clutch's armature, and a shaft-mounted rotor that serves as a magnetic coupling to the fixed field. This diaphragm flexes when energization of fixed field coil draws friction face into contact with rotor. De-energization permits diaphragm to return armature to disengaged position. When brake unit is included, energization of its coil draws armature into engagement in opposite direction.

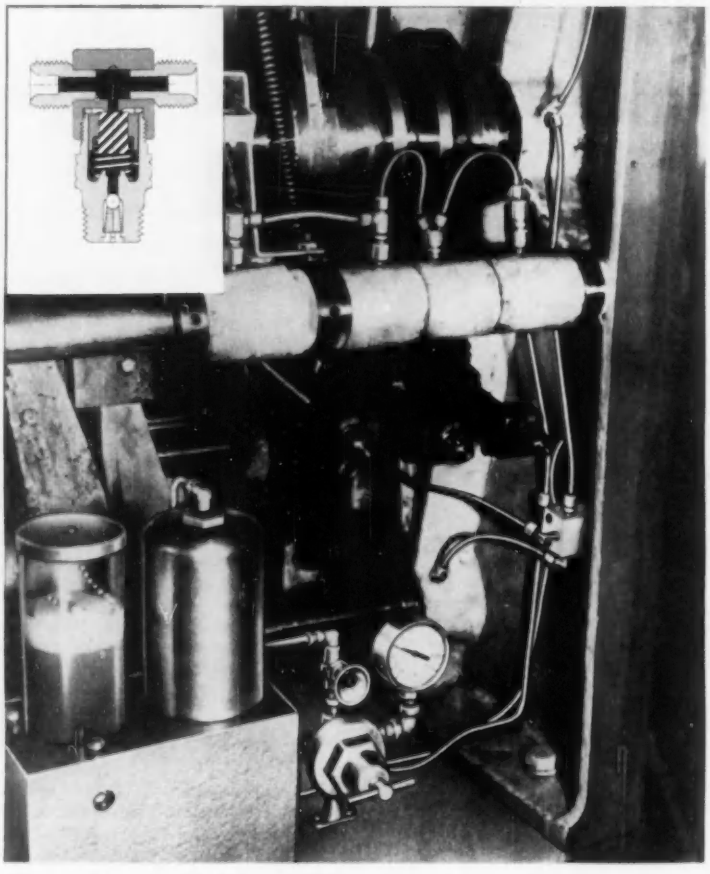
Choice of circuitry, together with size of unit, influences reaction time. Elapsed time can be as low as 0.005 sec. for smallest clutch, 0.010 sec for largest. Application of current to clutch and brake coils can be controlled to provide smooth, gradual start and stop, or sharp, high-speed start and stop.

Clutch torque capacities range from 10 in.-oz to 100 in.-lb, depending on size. Max speed for all models is 5000 rpm. Dia ranges from $\frac{7}{8}$ to $3\frac{1}{8}$ in., shaft dia from $\frac{1}{32}$ to $\frac{3}{8}$ in. Required coil power ranges from 2 to 14 w. Prices begin at about $30 for $\frac{7}{8}$-in. dia unit. **Simplatrol Products Corp., 24 Salisbury St., Worcester, Mass.**

Circle 1, inside back cover

CONTINUED ON PAGE 100





One stroke with air pump, . . .
in manual operation, lubricates 24 points on this spring-winding machine. Metering valve (inset) is shown charged for next delivery of lubricant.

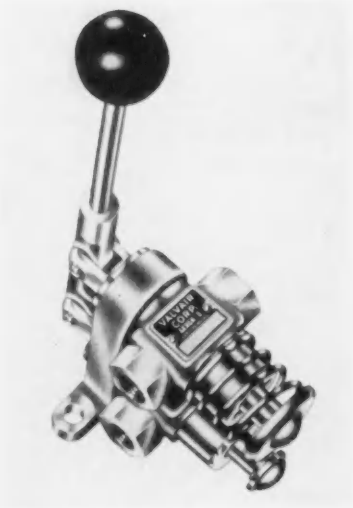
Miniature Lubrication System

This positive-displacement system is for use on machine tools, packaging, canning, labeling, textile and other machinery with numerous bearings. Heart of the system is a metering valve (slightly larger than a lubrication fitting) that services each bearing individually. The valve is said to deliver a specified amount of lubricant to each of the system's bearings regardless of bearing clearance or distance from the pump. Valve design eliminates lubricant drainage when the machine is idle.

Four different types of lubricant pumps are available to pressurize system lines and actuate measuring valves. A single-stroke vacuum pump connects to intake manifold of gasoline-driven engines. It delivers sufficient lubricant for up to 40 bearings. A single-stroke air pump serves up to 84 bearings, and operates on a regular shop air line. For longer lubricant lines, an air-operated reciprocating pump serves up to 200 bearings. A manually operated hand pump actuates up to 42 bearings in one stroke.

Valves are available in three delivery capacities: 0.003, 0.006, and 0.009 cu in. Basic types fit standard threaded bearing ports; snap-on types attach directly to threaded and drive fittings, insert type operates remotely from manifold blocks with tail tubes to bearing inlets. Systems are custom assembled for individual applications. **Alemite Div., Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago 4.**

Circle 2, inside back cover



Tandem-mounted control valves . . .

in three and four-way models with neutral position are designed for up to 250-psi-pneumatic, 325-psi-oil-or-vacuum service. Suitable for double mounting of a variety of basic valve types. Typical four-way valve applications include simultaneous operation of a pair of single-acting cylinders or positive control of a double-acting cylinder by using different combinations of three-way valves in pairs. Manual or spring-actuated neutral positioning is available. Tandem valve is interlocked to prevent both valves from operating at the same time. One-piece Navy "M"-bronze body and hard chrome-plated stainless steel stem are used in the straight-through construction. Available with open end or piped exhaust in port sizes from ¼ through 1 in. NPT. **Valvair Corp., 454 Morgan Ave., Akron 11.**

Circle 3, inside back cover

Panel-mounted remote control . . .

for infinitely variable speed drives from ⅓ to 3 hp permits setting to one part in 4000. Each turn of crank controls 100 divisions (one number is indicated on the counter for each turn of crank handle). A knob locks crank against rotation. Control

CONTINUED ON PAGE 102

EXTRAORDINARY BEARING PROBLEMS?

"REALI-SLIM" BALL BEARINGS

Ball radial — Angular contact — 4-pt. contact

Cross sections from ¼" to 1" and 4" to 40" bore diameters. Some sizes available from stock.

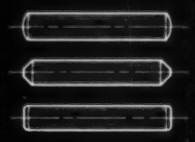
THIN SHELL NEEDLE BEARINGS

NEW!

Type KN

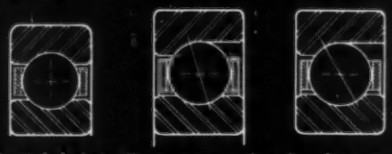
Standard sizes — in stock

NEEDLE ROLLERS



Spherical, conical or flat-end types

RADIAL BALL BEARINGS

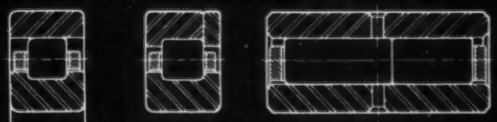


Conrad design, types LC, HC and BLC

Maximum capacity design, types HM, BLM

Angular contact design, types HA, BLA

RADIAL ROLLER BEARINGS

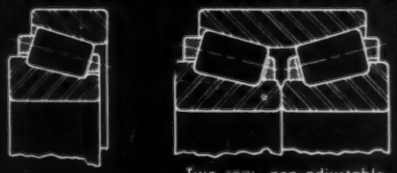


Lipped inner, straight outer race types RN, RX and RNW

Lipped inner, one lip outer, side ring type RP

Straight inner, straight outer, mill type RM

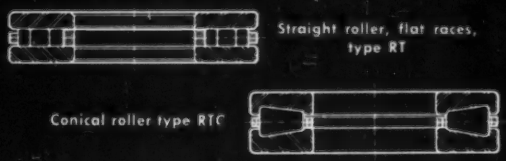
TAPER ROLLER BEARINGS



Single row type TS

Two row, non-adjustable type TNA

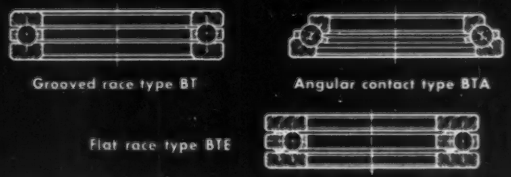
THRUST ROLLER BEARINGS



Straight roller, flat races, type RT

Conical roller type RTC

THRUST BALL BEARINGS



Grooved race type BT

Angular contact type BTA

Flat race type BTE

ECONOMICALLY SOLVED AT KAYDON

When bearing problems seem next to impossible — when design considerations appear insurmountable — it's time to call KAYDON.

You'll find KAYDON'S full-time, experienced bearing-design engineers can take your problem in hand — and take worries off your mind. Their record is one of remarkable success — designing and producing bearings others said "couldn't be made."

Extraordinary bearing problems are KAYDON'S daily assignment. The tougher the better! If your designs require bearings of exceptional thrust or radial capacity, close-tolerance precision and/or *"Reali-Slim"* section, or extra-large diameter bearings up to 130" O. D., call or write KAYDON for specific recommendations, economical solutions. You'll be glad you did.

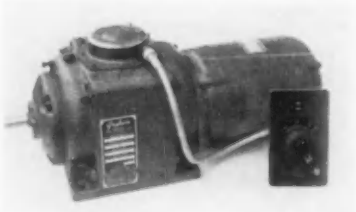
THE KAYDON ENGINEERING CORP.

MUSKEGON • MICHIGAN

K-572

All types of ball and roller bearings — 4" bore to 130" outside diameter . . .

Taper Roller • Roller Thrust • Roller Radial • Bi-Angular Roller • Needle Roller • Ball Radial • Ball Thrust Bearings



is available with standard lengths of flexible cable from 1 to 6 ft and may be used for greater lengths with one or two sections of flexible cable in combination with a solid rod extension. The control permits accurate remote settings of speeds for machine-tool feeds, feeder and pump-rate settings, proportioning controls and other applications. **Graham Transmissions, Inc., Menomonee Falls, Wis.**

Circle 4, inside back cover

Heat control . . .

operates by varying the integrated input wattage on electric heating devices rated to 1500 w, 115 v ac. Adjustment is made by turning knob to desired temperature. Cams, sliding contacts and a motor have been eliminated. Applications include remote temperature control, marking and heatsealing machines, and conductive heating pads. **George Ulanet Co., 413 Market St., Newark 5, N. J.**

Circle 5, inside back cover

Self-regulating relief valve . . .

and hydraulic aspirator or jet pump have been combined into one unit. It pressurizes a hydraulic reservoir and provides suction for pump operation by use of pump discharge pressure. With 3000-psi hydraulic pressures applied at oil inlet port, 0.55 gpm is automatically metered by the valve to cause ambient air to be drawn in through air in port. Air and oil are then discharged through outlet to reservoir where separation occurs. Pressure in reservoir rapidly increases because of increase in air pressure. Valves now in production pressurize a 1000 cu in., reservoir-trapped, air volume to 10 psig in 20 sec, 20 psig in 30 sec, 30 psig in 1 min and 40 psig in 1 min and 40 sec, starting with 0 reservoir pressure at sea level. Weighs 1.05 lb. Operates —65 to 275F. **Vinson Mfg. Co., 8044 Woodley Ave., Van Nuys, Calif.**

Circle 6, inside back cover

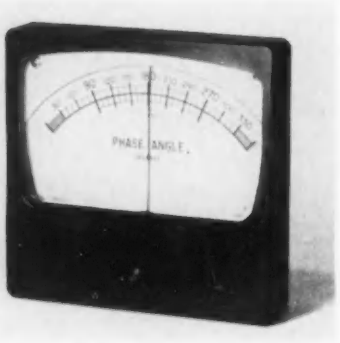
Colored Teflon rod stock . . .

in 11 colors meets NEMA and military specifications. For parts that must be clearly color identified. Heat-stable pigments are inert and do not affect electrical and mechanical properties of material. Inherent characteristics of Teflon are not impaired by the pigment. Supplied in $\frac{1}{32}$ to 2 in. dia. Uses include feed-through and stand-off insulators and electronic components. **Chemplast, Inc., 3 Central Ave., East Newark, N. J.**

Circle 7, inside back cover

Meter retains reading . . .

by means of a rear-mounted solenoid that is normally energized. When a reading is to be retained, solenoid is de-energized and nylon-headed plunger pushes against back of face plate, holding pointer fast. Suited for applications where readings at a given time must be known but cannot be noted immediately, including remotely located meters or batteries of meters with a number of different but related readings. Readings may be taken at any point on meter scale, not necessarily at the max reached by the signal. Available in sensitivity ranges from a few microamp or milliv to 50 amp or 500 v, dc or ac. Built on a 4½-in. rectangular plastic case. On present models, solenoid coil operates on 100 v dc and about 30 milliamp. **Assembly Products, Inc., Chesterland, Ohio.**



Circle 8, inside back cover

Subminiature servo motor . . .

measures $\frac{1}{4}$ x $1\frac{17}{32}$ in. Consists of a squirrel-cage rotor mounted on ball bearings, a two-phase stator and a stainless-steel housing. Motor can be supplied with shafts for specific applications; has number 5 frame; it is rated 26 v, 400 cps. Operates on a power input of 3.3 w in a temperature range of —67 to 158 F. For use in servo systems requiring instant response to input signals. **Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.**

Circle 9, inside back cover

Indicating controller . . .

is explosionproof to conform to UL categories Class I, C and D, and Class II, E, F and G. The box mounted atop the standard control case contains the electrical snap switch. The standard unit can be modified. Controller has one SPDT switch and two dial pointers; one to indicate set point, the other for process temperature. Features include swivel-mounted and Type 316 corrosion-resistant stainless steel capillaries and a choice of housing colors. Temperature ranges extend from

—CONTINUED ON PAGE 104

are you fighting SPACE?

No need to suffer from engineering claustrophobia, if you design with CANNON PLUGS in mind!

Coaxials. Screw-type coupling Low VSWR. for 50-, 70-, 93-ohm cable

K miniatures 3 to 50 contacts 13 different arrangements

DP Type Rack-Panel-chassis style 2 to 57 contacts

MC Sub-Miniatures 3, 6, 12 contacts Built for rugged use

D Sub-Miniatures 9 to 50 contacts Same space... same weight!

Cannon Miniature and Sub-Miniature Plugs are rugged, easy mating, unusually versatile, neat and compact. When you design with Cannon Miniatures in mind you'll get complete electrical circuit dependability in a very small space. Up to 50 contacts in ½ or ⅓ the area taken by standard multi-contact connectors!

Rectangular and circular types. Hermetically sealed, vibration and moisture resistant, and general purpose designs. Contacts for 5, 10, 15, 25 amps... and miniature coaxial connectors. Practically all five ampere contacts are gold plated. High dielectric insulation in phenolics, resilient materials, glass seals, Zytel, Diallyl Phthalate and Melamine. Aluminum alloy or steel shells, depending upon application.

Miniature lines include: DPA, DPX, DPM, DPG, K, MM, MR and Diamond MB and SM Coaxial connectors. **Sub-miniatures:** D, MC, and Diamond DIC Coaxial connectors.

Write TODAY for new 32-page 2-color Miniatures Bulletin HMC-2. Also, write for Bulletin SM-1, "Soldering Small Contacts."

For an interesting discussion of the broad subject of "Reliability," write for Cannon Bulletin R-1.

CANNON PLUGS

WHERE RELIABILITY IS THE 5TH DIMENSION

Please refer to Dept. 106

CANNON ELECTRIC CO., 3208 Humboldt Street, Los Angeles 31, California. Factories in Los Angeles; Salem, Massachusetts; Toronto, Canada; Melbourne, Australia; London, England. Manufacturing licensees in Paris and Tokyo. Representatives and distributors in all principal cities. See your Telephone Yellow Book.

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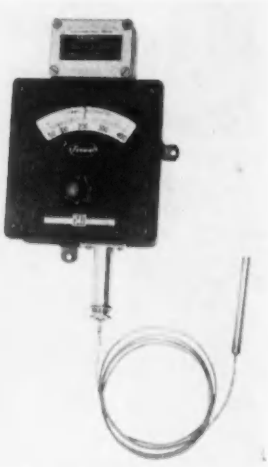


—150 to 700 F, with C scales on request. Bulb sizes are ¼, ⅜ and ½ in. coiled to ¾ in. OD. Capillaries are 6 and 10 ft with special length to 20 ft on request. **Fenwal, Inc., Pleasant St., Ashland, Mass.**

Circle 10, inside back cover

Preset counter . . .
may be actuated by photoelectric control, microswitch, impact switch, limit switch, pressure switch, flow meter, or any type of SPST switching device. Counting rate to 450 per min. Provides a count selectivity of 1 to 1000 directly by means of selector switches. Automatically and instantaneusly recycles to zero position after each completed count. Size is 10 by 12 by 6 in. Operates on 115 v or 230 v, ac, 60 cps. Price, $239 FOB N. Y. factory net. **Hobson Miller Machinery Corp., 280 Lafayette St., New York 12.**

Circle 11, inside back cover

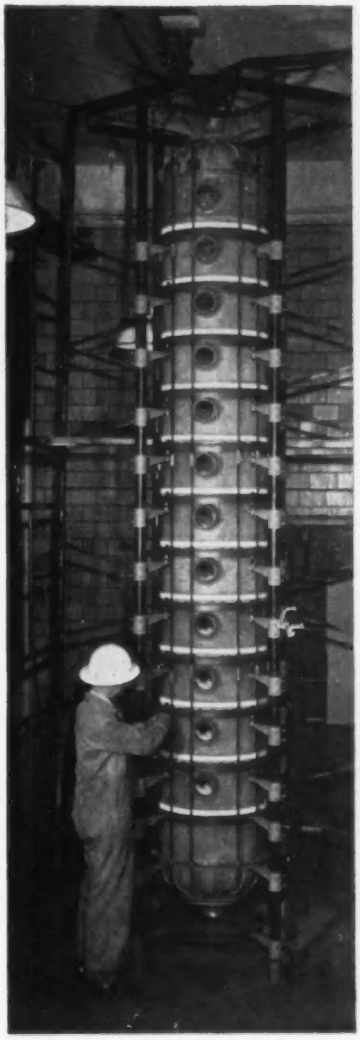
Counter-timer . . .
measures: frequency to 1 megacycle, time and period in 1 microsec increments, phase angles in 0.1° increments, events to seven

(Continued on page 109)

THIS IS GLASS

a bulletin of practical new ideas *from Corning*

A tall tale of bubbles without troubles . . . plus a few other ideas



What you're looking at is an *all-glass* bubble cap distillation column, the *largest* ever built using glass for *all* the main components.

The people who came to us for this outsized (16′ high, 23½″ diameter, 2,000 pounds) bit of plumbing make metallic silicon.

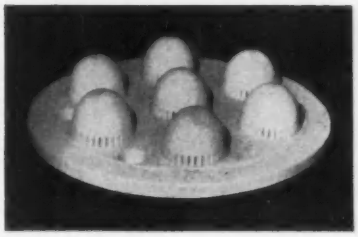
What's uppermost in their mind is product *purity*. Which means process equipment must *not add to nor take from* what's put through it.

Therefore, glass (what else?)—with all the parts custom-fashioned by us (who else?).

The big cylindrical sections (including 4-inch conical pipe flanges) are of No. 7740 glass that stands up to just about every kind of chemical attack.

Between each section you'll find bubble cap plates—12 in all, *twice* the usual number for added purity.

Made from a high-silica, heat-resistant Vycor brand glass, these plates weigh 65 pounds apiece. They look like this.



To make them, we use the Multiform process, a method in which powdered glass is slip cast, then *fused* to make complex shapes possible.

Don't stop yet . . .

OK, *you* don't make metallic silicon. Maybe you have nothing to do with chemical processing. Still there's probably something you want that Corning can help with.

Like? Selective transmission of infrared or ultraviolet rays. There are various types of Vycor glassware to handle such tasks.

Shoulder beads, headers, transistor beads, diode cases? Multiform gives you these with excellent *dimensional accuracy*.

Or maybe capacitors, resistors, attenuator plates and such. You get facts on these in a folder sized to fit the inside pocket of your suit coat.

The Vycor *line* is explained in Bulletin B-91. Multiform data sheet and/or samples on request. Also for your files: PE-60, "Pyrex brand industrial radiant heater catalog," telling all about longwave, *area*-source heating.

And "This Is Glass," a sprightly review of what glass is doing, and can do for you. Use the coupon.

Precision glass tubing tackles tough transformer task

Follow a coast-to-coast telephone cable and you'll find relay stations every three miles or so.

At these relay points are two tiny transformers. And inside the transformers of one manufacturer you'll find coils formed around short lengths of Vycor brand *glass* tubing.

This tubing we make from one of our 96% silica glasses—a very *high-quality* stuff, notable for its lack of bubbles, striae or cords, the kind of things that *might* hamper machining operations.

Vycor tubing was picked for a number of reasons, *all* of them adding up to the fact that these transformers have to *last 30 years* without replacement, since some are installed in remote mountains, and others buried in river beds.

First off, Vycor tubing won't cause any trouble when temperature changes occur. It has excellent *dimensional stability*, having an expansion coefficient of 8.0 x 10^{-7} per °C.

Vycor tubing also offers high chemical stability. Even though metallic coatings are applied to the glass, there's *no* reaction or corrosion.

Finally the tubing can be *finished* to high precision on both inside and outside diameters. And where needed, threads or other shapes can be cut in the glass.

Precision Vycor brand tubing is *not* much *to look at*, but it *is* something to measure. Inside diameter is held to ±.001″, with wall thickness controlled to +.015″ and a minus *nothing*.

Take a close look and you can see the keyway slot cut into the tubing. It's held to ±.003 in width and ±.002″ in depth.

You can get precision Vycor brand tubing with ID's from ¼″ to 3 inches, in lengths up to 36 inches. If you can use some, or want more details, contact Railroad and Industrial Sales at the address shown.

Corning means research in Glass

CORNING GLASS WORKS, 51-2 Crystal Street, Corning, New York

Please send me the following material: ☐ Bulletin B-91; ☐ "This Is Glass"; ☐ PE-60

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SCIAKY
HELPS PUT PROFIT
INTO MANUFACTURING

Seam Welding—How to Use It To Improve Product Design and Quality

What is Seam Welding?

Seam welding is a method of fastening two metal piece parts with an uninterrupted joint, such as cylinder side seams, joining fuel tank halves, etc. It is a process that lends itself efficiently and economically to electric resistance welding techniques.

In practice, the two pieces of metal to be joined are overlapped and passed between a pair of rotating electrode wheels. Current is passed through in such a manner as to produce a line of overlapping spot welds. The resultant seam is pressure tight.

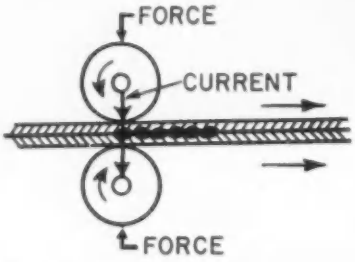


Fig. 1 Seam welding process.

Variations of the seam weld include *roll spot welding* in which the welds are made in the same manner but not overlapping. This method permits highly accurate spacing of spots.

Another form is the *mash seam weld* in which the materials to be welded are overlapped from one-half to twice the thickness of the sheet. The seam welder wheels actually mash or flatten the weld area to produce a seam only slightly thicker than one sheet of the welded material.

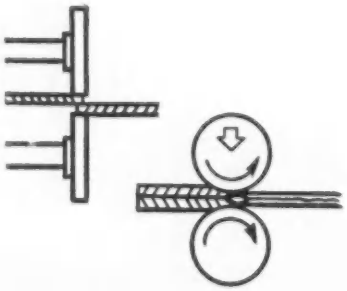


Fig. 2 Mash welding process.

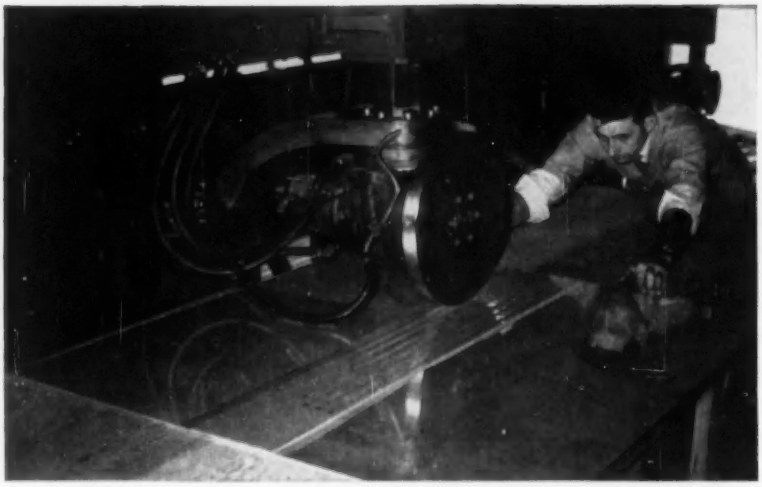


Fig. 3 Roll spot operation welding .125″ to .125″ of flat sheet aluminum alloy.

Advantages of Seam Welding

The seam welding process is readily adaptable to high production work which requires long linear welds. Pressure tightness is inherent.

Appearance of the weld is good. Minimum finishing is necessary only where surface appearance is critical. Distortion, so common in fusion welding, is negligible.

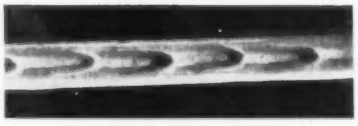


Fig. 4 Macrograph for continuous seam weld of .032″ to .032″ 24ST Alclad aluminum. Overlapping of the welds insures a water and fume tight seam.

Design Considerations for Seam Welding

As a guide to spacing which will produce an air or water-tight weld, there should be approximately 12 spots/in. in lighter gauges at a production rate of 12 feet/min. For heavier gauges figure about 8 spots/in. at a 2 feet/min. production rate.

Functional joint design will provide considerable savings if the piece part edge distance and work clearance can be accommodated by standard welder arms and electrode wheels.

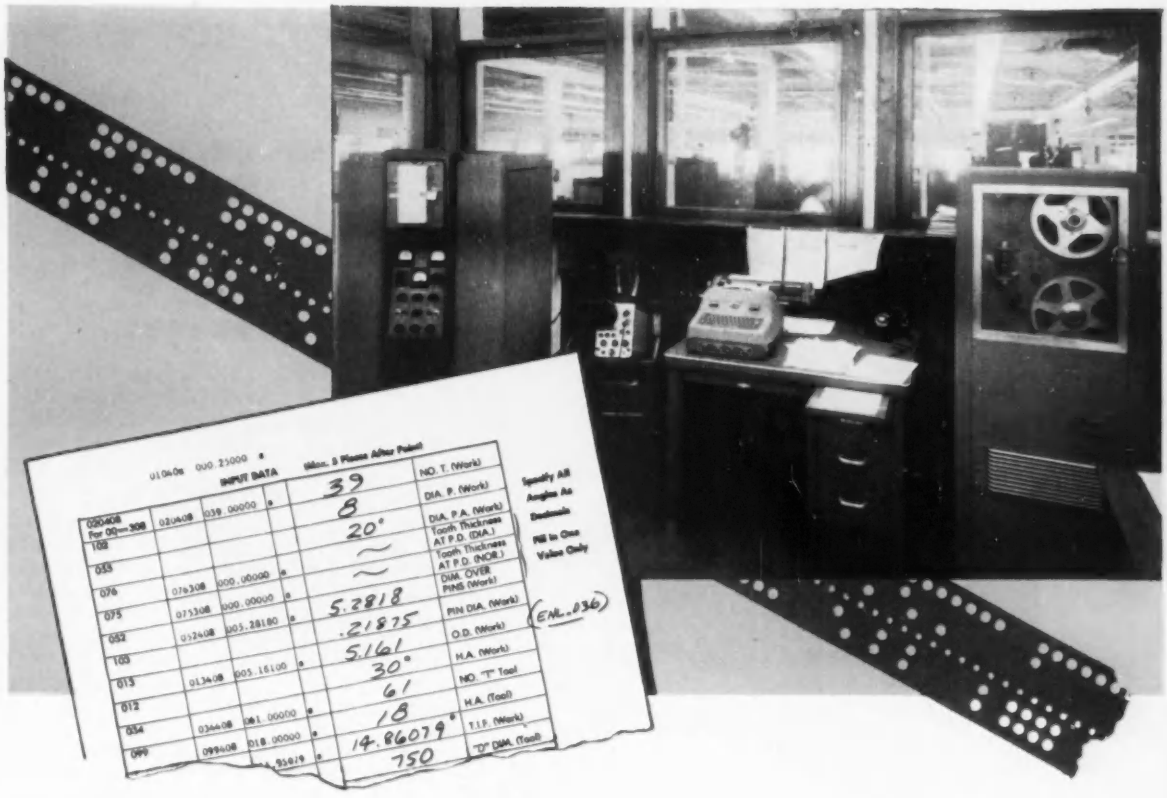
Sciaky Research Assistance

Facilities of the Sciaky Research Division at Los Angeles, California, are available for contract research to answer resistance welding problems. Housed in a 15,000 sq. ft. building, these facilities include an experienced engineering staff, a complete range of the most advanced resistance welding machines including the largest in the world and a laboratory equipped for metallography, chemistry, electronics, photography and testing as applied to resistance welding. Write for further information and ask for the 20-page Research Division brochure.

Write Today for Free Sciaky Literature

Start to build your data file on resistance welding today. Designers' Guide Bulletin 331 discusses seam welding and other forms of resistance welding.

Describe your particular fastening problem on company letterhead and we will send suitable back and future issues of our "Resistance Welding At Work" publication. All contain impressive examples of Sciaky's basic thinking—resistance welding techniques designed to do *more useful work at lower operating costs* with *maximum reliability*. **Sciaky Bros., Inc., 4913 West 67th Street, Chicago 38, Ill., POrtsmouth 7-5600.**



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Fellows Gear Shapers tooled with Fellows Cutters lower costs and speed production on internal and external spur, helical and herringbone gears. Many examples of interest to designers are shown in the booklet, "The Art of Generating with a Reciprocating Tool." Just write any Fellows office for your copy.

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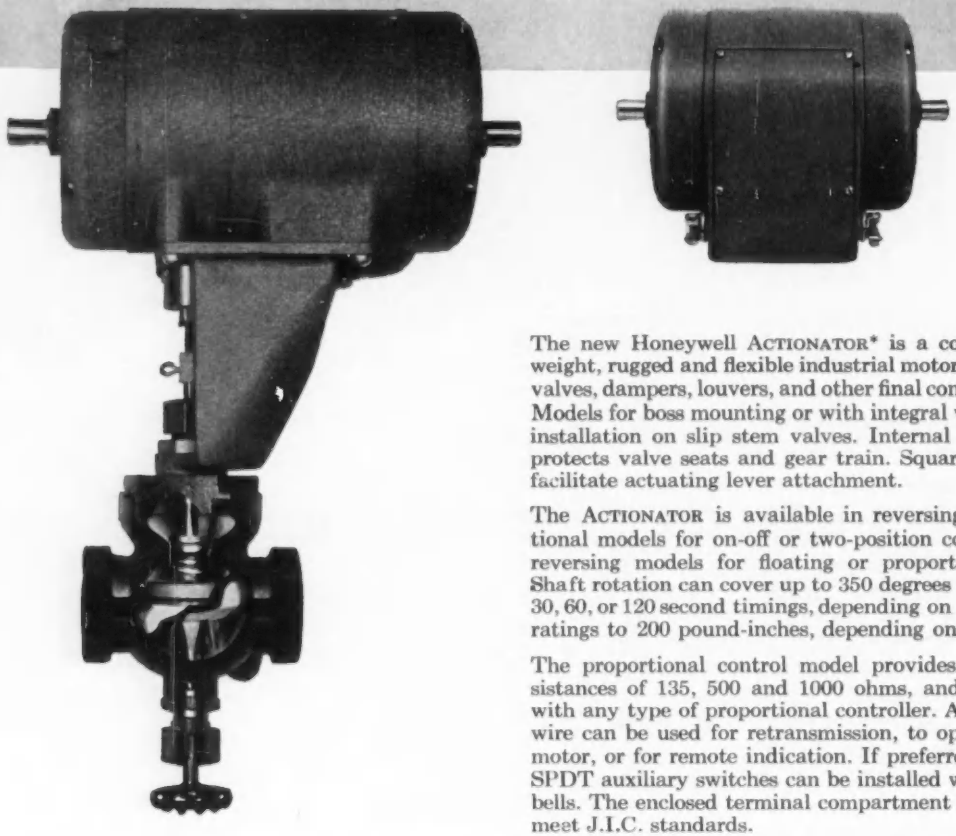

The new Honeywell ACTIONATOR* is a compact, lightweight, rugged and flexible industrial motor for operating valves, dampers, louvers, and other final control elements. Models for boss mounting or with integral valve yoke for installation on slip stem valves. Internal strain release protects valve seats and gear train. Squared shaft ends facilitate actuating lever attachment.

The ACTIONATOR is available in reversing or unidirectional models for on-off or two-position control, and in reversing models for floating or proportional control. Shaft rotation can cover up to 350 degrees in 7½, 10, 15, 30, 60, or 120 second timings, depending on model; torque ratings to 200 pound-inches, depending on motor speed.

The proportional control model provides slidewire resistances of 135, 500 and 1000 ohms, and can be used with any type of proportional controller. A second slidewire can be used for retransmission, to operate another motor, or for remote indication. If preferred, SPST and SPDT auxiliary switches can be installed within the end bells. The enclosed terminal compartment is designed to meet J.I.C. standards.

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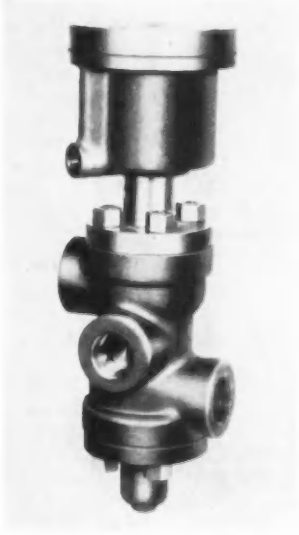
digits, and ratio of two frequencies. It can also act as a secondary frequency standard. Illuminated 1-in. high numerals are said to be readable at distances up to 30-40 ft. **Systron Corp., 2055 Concord Blvd., Concord, Calif.**

Circle 12, inside back cover

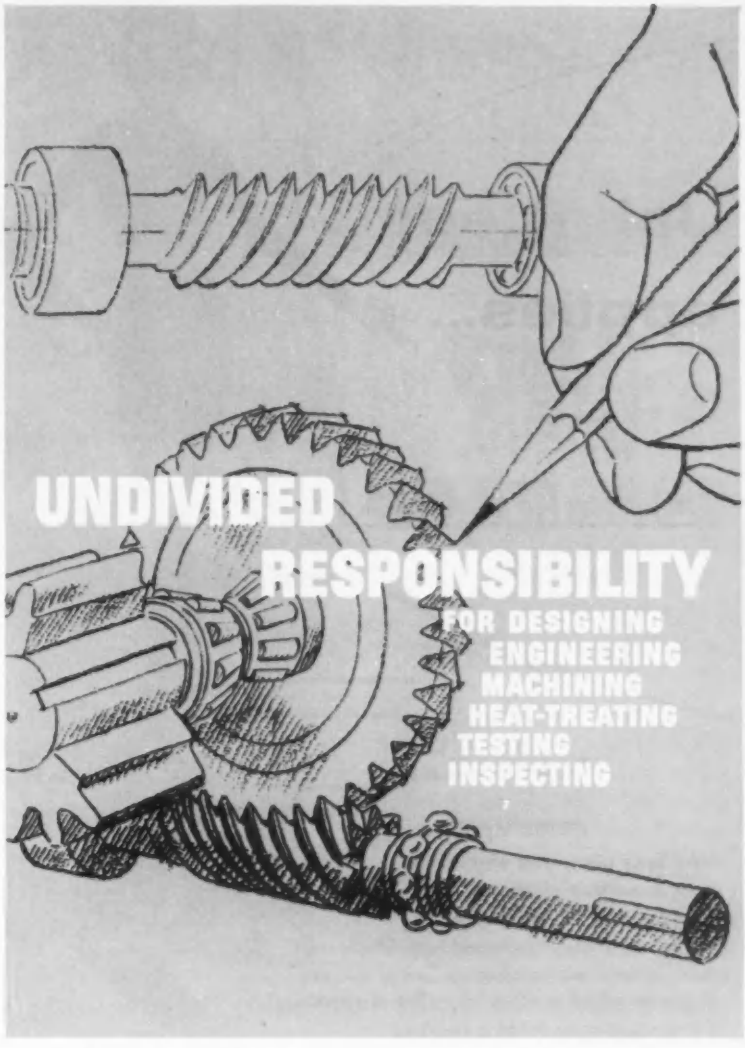
Portable heavy-duty pump . . . develops pressures up to 10,000 psi. The fhp hydraulic-motor pump can be used to replace mechanical power or wherever hydraulic power is used. Rated for 10,000,-psi-intermittent and 5,000-psi-continuous duty, the pump delivers 80 cu in. oil per min. It is driven by standard ½-hp, single-phase, 60-cps, 1750 rpm, 110-to-220 v motor. The electric motor pump weighs 65 lb. **Tal Bending Equipment, Inc., Milwaukee 2.**

Circle 13, inside back cover



Cylinder-operated valves . . . for 600-to-4000-psi hydraulic use are suitable for water, glycol and oil-base hydraulic fluids. Integral double-acting cylinder operates on 60 to 140 psi, using air, water or oil. Available in two or three-way types. Port sizes are 1, 1¼ or 2 in. NPT and valves are fitted for remote pilot control. Valves have Navy-M-bronze bod-

(Continued on page 118)



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ies, hardened stainless steel valve stems and replaceable seat sleeves, as well as Stellite seats. **Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11.**

Circle 14, inside back cover

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Circle 15, inside back cover

Fast-response thermocouple . . . has MgO-insulated lead welded to sheath but electrically insulated from tube or well with a ceramic coating for temperatures from —320 to 1900 F. Design can take pressures to 2000 psi. Added features of thermocouple are its resistance to erosion, corrosion and nuclear radiation. **Aero Research Instrument Co., Inc., 315 N. Aberdeen St., Chicago 7.**

Circle 16, inside back cover

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(Continued on page 112)

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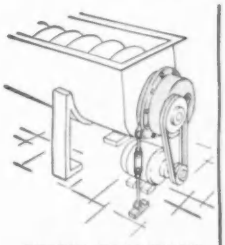
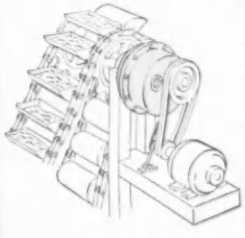


SCREW CONVEYOR



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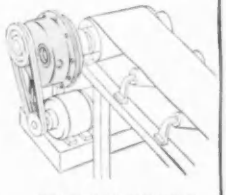
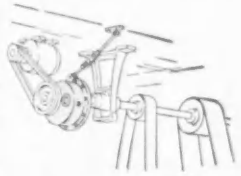


BELT CONVEYOR

APRON FEEDER



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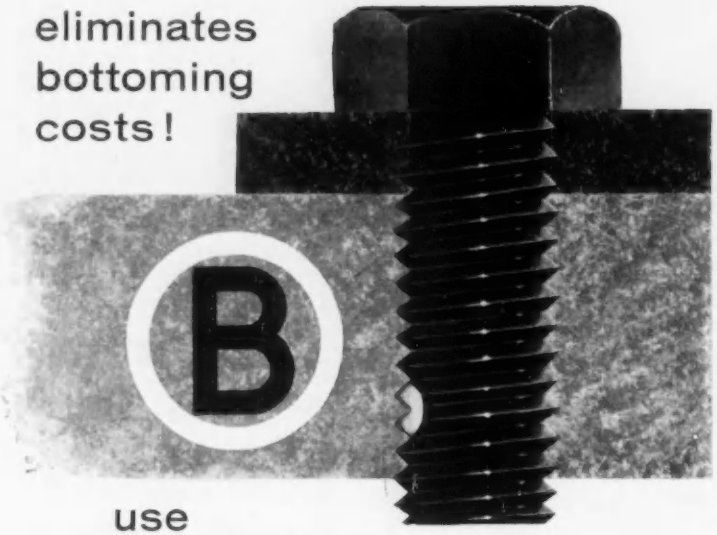

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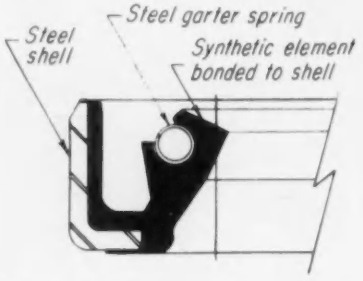

—40 to more than 250 F. Model 73-B is fitted with a steel garter spring. Stainless steel springs can be ordered for corrosive environments. The shell to which the synthetic-rubber sealing element is firmly bonded is also steel or stainless steel, as desired. **Garlock Packing Co., 417 Main St., Palmyra, N. Y.**

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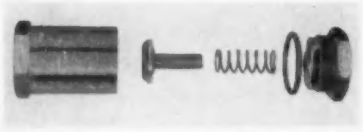

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are designed to handle fuels, oils, gases and other fluids at temperatures from 300 to 2000 F. Basic design can be used for poppet valves, ported or selector valves for manual, electrical, hydraulic or pneumatic actuation. Valves are all-metal, usually stainless steel or nickel alloys. **Skinner Seal Co., 3001 Sutter St., Santa Ana, Calif.**

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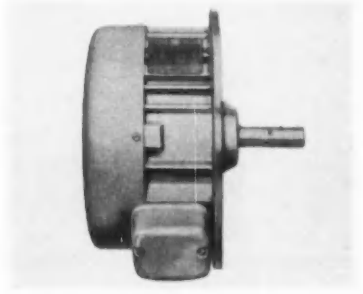

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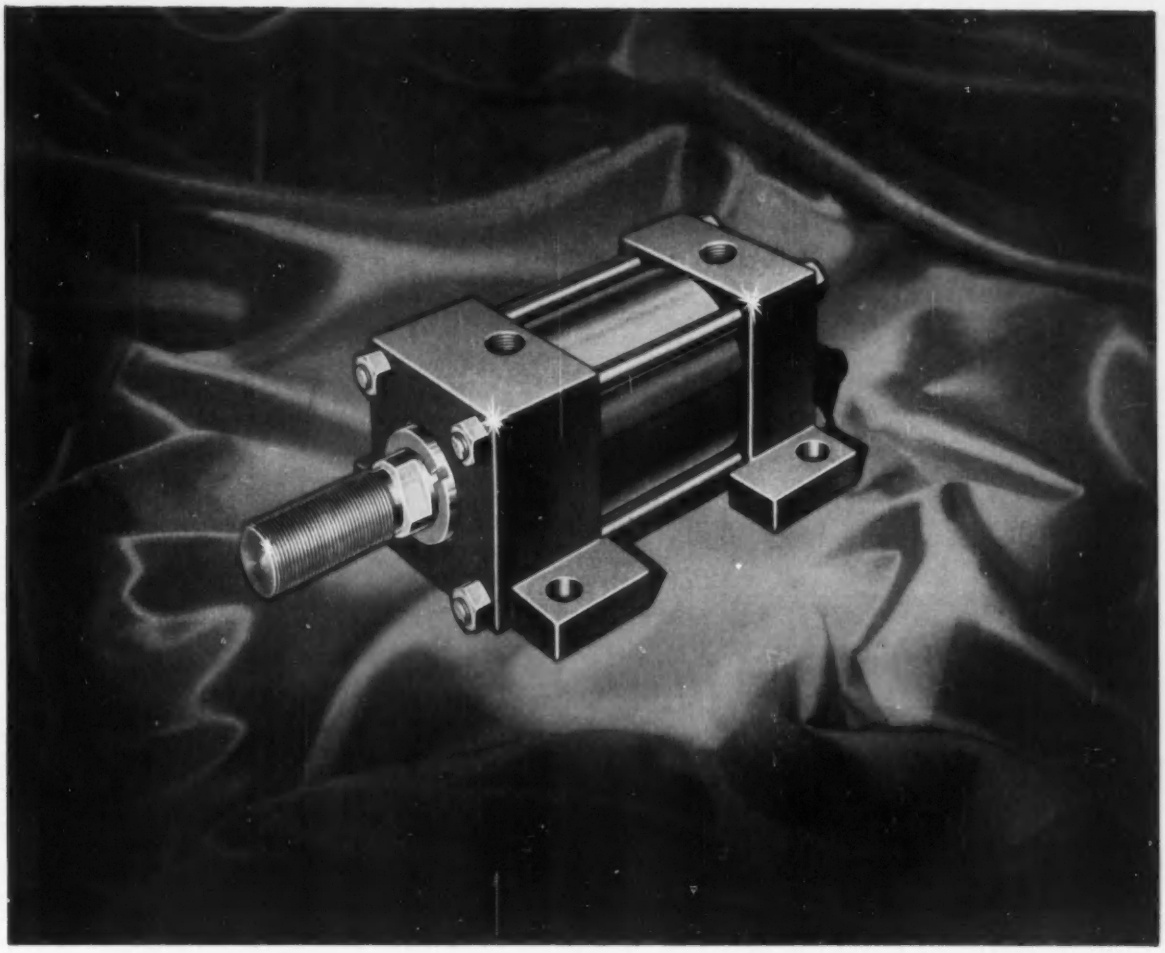
(Continued on page 116)



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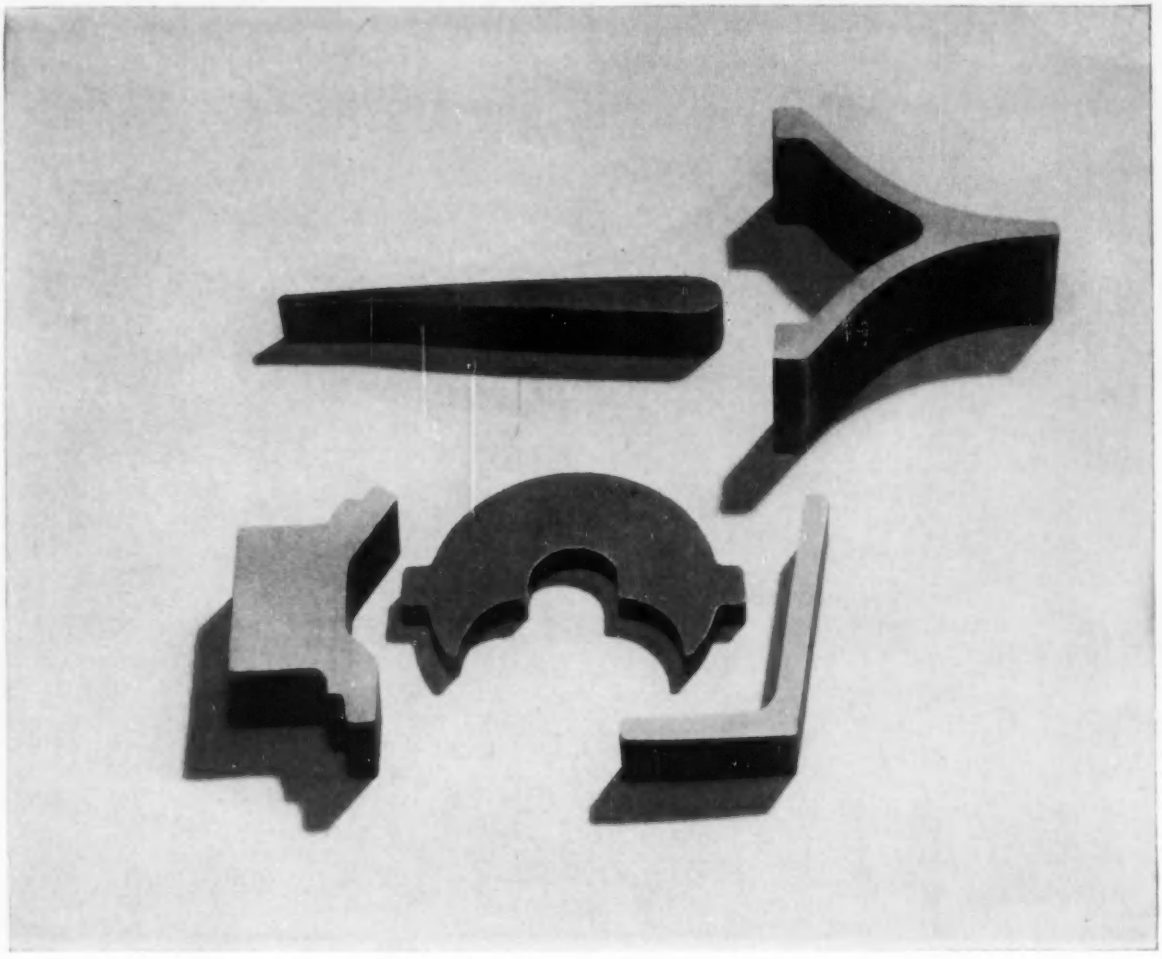

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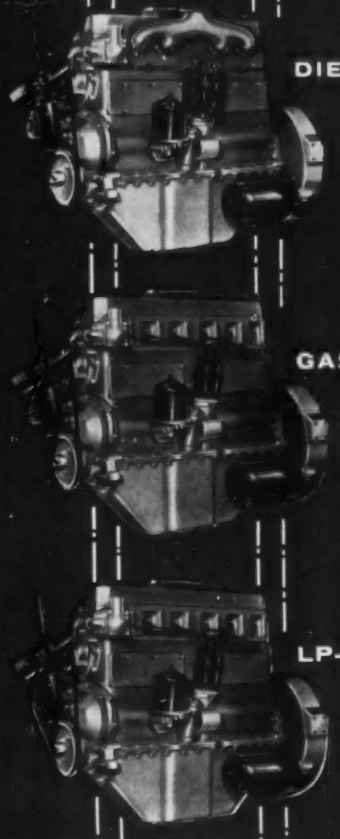

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1200 and 900 rpm. Can be mounted vertically or horizontally. Bearings are factory-lubricated. **Louis Allis Co., Dept. P, 427 E. Stewart St., Milwaukee 1.**

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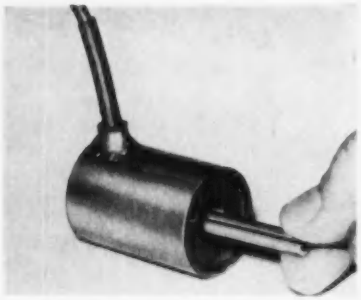
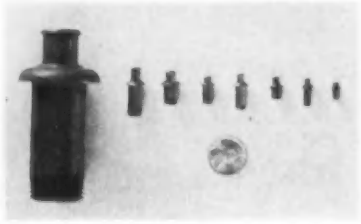


Transducer . . .

is explosionproof and operates in temperatures to 500 F. The coil, wound with glass-insulated wire, is vacuum-impregnated with silicone varnish. Stainless steel stuffing box is welded to housing. Enclosure is a heliarc-welded stainless steel shell. Unit is 2⅛ by 1¼ in. OD. Range is ±0.150 in. For a 20 v, 400 cps supply, output is 0.001 amp through a 500 ohm load for 0.050 in. armature motion. **Automatic Timing & Controls, Inc., King of Prussia, Penna.**

Circle 20, inside back cover



Drive-pin rivets . . .

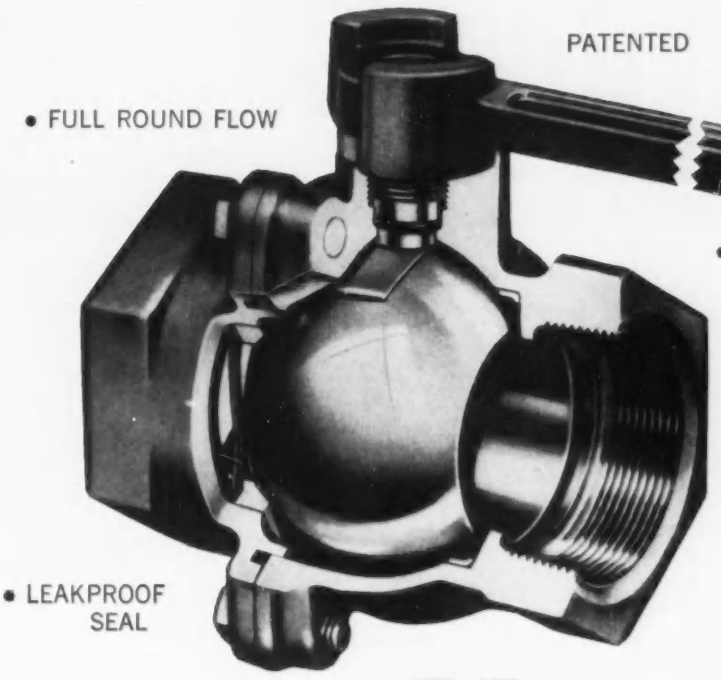
are for blind-side clearance problems. The stainless steel rivets are available with flush or protruding heads. Weight is said to be lower, installed, than comparable fasteners. Shear strength is said to be up to 95,000 psi. Developed for aircraft manufacturers in the fabrication of thin wings and tails and missiles. **Deutsch Fastener Corp., P.O. Box 61072, Los Angeles 61.**

Circle 21, inside back cover

Teflon O and V-rings . . .

have dimensional tolerances of 0.001 in. and less. Based on a new, high-density plastic stock, the machined seals are for extreme-temperature, pressure and corro-

(Continued on page 120)



Who sends Valentines to a Rockwood Ball Valve?

Rockwood Ball Valves are operating, without leakage, in plants throughout the country, and the pleased comments we receive read like valentines:

A brewing company has opened and shut their Rockwood Ball Valves over two million times — and their valves are still going strong!

An oil company was surprised (although we don't know why — it's a common occurrence) when Rockwood Ball Valves stopped leakage other valves could not stop.

A company boiling starch found Rockwood Ball Valves lasted longer than any other valve previously used.

A tannery tells us Rockwood Ball Valves are the quickest, easiest valves to open and close.

Frankly, we can't blush — it would be false modesty. Rockwood Ball Valves are perfect for many jobs — we build them that way. They come in all pipe sizes, rated at 300 W.O.G. Tell us where to send it — and we'll give you a booklet with complete information. Valves are tested and listed by Underwriters' Laboratories, Inc. Distributors in principal industrial areas.

ROCKWOOD BALL VALVES

FULL, ROUND FLOW

ROCKWOOD

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Weldynamics

ARC WELDING AT WORK CUTTING COSTS

How cost is reduced 37% ...weight cut 61% by Weldynamics

CP-5100 Coin Ram Dimpler. Fabricated by Chicago Pneumatic Tool Co., New York 17, New York.

Here's how Weldynamics has solved the problem of rigidity, accuracy and cost for a machine builder. With welded steel design the weight was cut from 18,000 pounds to 7,000 pounds *while holding alignment accuracy to .003"*. The cost was reduced from $2700 for a casting to $1700 for the weldment.

Weldynamics saves money because steel is 3 times as strong, 2½ times as rigid and costs a third as much per pound as cast iron.

How to put WELDYNAMICS to work for you

Lincoln field engineers, trained in Weldynamics, will help you design lower costs into your products. They stand ready to advise and recommend on procedures, equipment and electrodes to cut your welding costs.

New, 11th edition, "Procedure Handbook of Arc Welding Design and Practice" has 1300 pages, 1100 illustrations, 260 pages on machine design. $3.00 in U.S.A., $3.50 elsewhere.

Machine Design sheets published regularly give tips on welded design. No charge to Design Engineers and Production Supervisors. Just write us.

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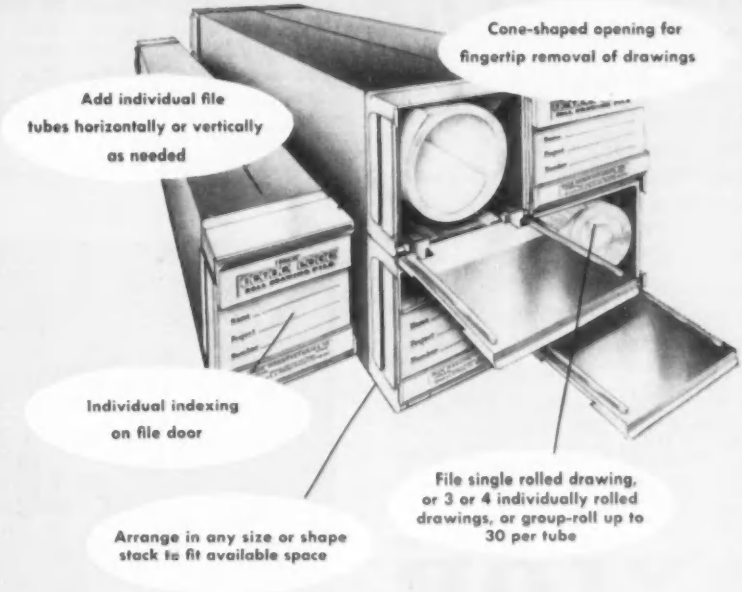
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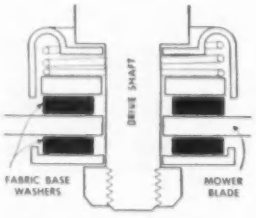
How a Taylor Laminated Plastic safety clutch protects rotary lawn mower crankshafts

Friction disc assembly permits clean cut, prevents damage to drive mechanism

Running into rocks or other solid objects with a rotary lawn mower is not a recommended practice, but it is possible to strike these objects without damaging the drive mechanism.

A laminated plastic safety clutch assembly does the job. Two Taylor Laminated Plastic friction discs, mounted as shown in the drawing, drive the cutting blade with positive force until a solid object is struck. When this occurs, the clutch assembly absorbs the shock, the discs slip, and the blade stops without impeding the operation of the driving mechanism—all parts are protected from serious damage.

Perhaps you have a similar problem—or others that can be solved by using either laminated plastic or vulcanized fibre parts. Our application engineers will be glad to help with your specific needs and recommend the material best suited to your application. Get their assistance by contacting the Taylor sales office nearest you.



CROSS SECTION of slip clutch assembly showing arrangement of components on crankshaft of rotary lawn mower.

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Vulcanized Fibre

TAYLOR FIBRE CO., Plants in Norristown, Pa., and La Verne, Calif.

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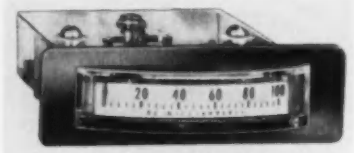
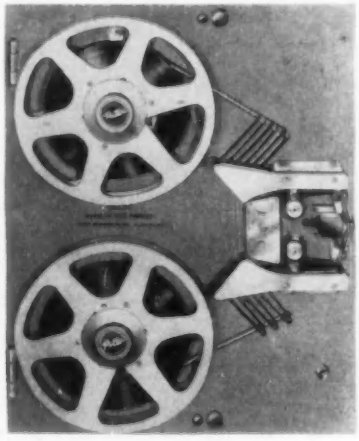
sive applications. Initial production consists of O and V-rings with square, round and oval cross-sections. Sizes are presently limited to $\frac{3}{32}$ in. to a max OD of $\frac{11}{16}$ in., $\frac{1}{4}$ in. ID. Wall thicknesses can be kept to 0.062 in. on a production basis to 0.012 in. on small-lot or developmental seals. Seals have been subjected without failure to pressures of 30,000 psi, temperatures of —200 to 425 F and corrosives like fuming nitric acid. **Tri-Point Plastics, Inc., 175 I. U. Willets Rd., Albertson, L. I., N. Y.**

Circle 22, inside back cover



Spacesaving panel meter . . .
provides visibility of conventional 2½ in. meter, but is said to use only half the panel space. These 5-oz meters are accurate to 2% of full scale in dc ranges. Uses core magnet meter movement. Mounted in dustproof lucite cases and supplied with bezel, escutcheon plate and two speed nuts for mounting. Carried in stock in 15 ranges and types, such as dc voltmeters, dc ammeters, dc milliammeters, dc microammeters, volume-level indicators and ac voltmeters. **Simpson Electric Co., 5200 W. Kinzie St., Chicago 44.**

Circle 23, inside back cover



Magnetic-tape handler . . .
is transistor-equipped and may be remotely controlled. High and low tape speeds are available in ranges of four speeds forward and reverse to 150 in. per sec. Rewind or search tape speeds are 400 in. per sec.

(Continued on page 124)

Over $1,000,000 a year

saved with OILITE Precision Parts

This kit contains intricate parts used by a score of companies who save over $1,000,000 annually by specifying Oilite*!

These companies are typical of many manufacturers of appliances, machinery, automotive accessories, power tools and other products who enjoy the substantial cost reductions made possible by Amplex Powder Metallurgy.

You, too, can have a share in these savings. Chrysler-engineered Oilite Precision Parts can save you up to 55% or more when produced in volume. What's more, you'll find Oilite powder metal parts tough and long wearing. They're available in a large variety of metals and alloys to meet required properties.

Your local Oilite Engineer will be glad to provide complete information on any application. Furthermore, he will gladly survey all the parts you now buy for possible cost reductions *at no obligation*. Look for him in the Yellow Pages of your telephone directory under "Bearings — OILITE" or write to Dept. A-2.

Engineers in the principal cities in US and Canada.

TYPICAL PROPERTIES OF STEEL OILITE* PRECISION PARTS

(Grades)	A	AC	AH
Fatigue Strength (Psi) 10,000,000 reversals	24,000	-----	------
Ultimate Tensile Strength (Psi)	35,000	50,000	120,000
Compressive Strength (Psi) .001" permanent set	25,000	80,000	150,000
Elongation in 1", % minimum	10	5	1
Brinell Hardness	80	140	300
Shear Strength (Psi)	27,000	35,000	100,000

* Many other materials giving different properties available.

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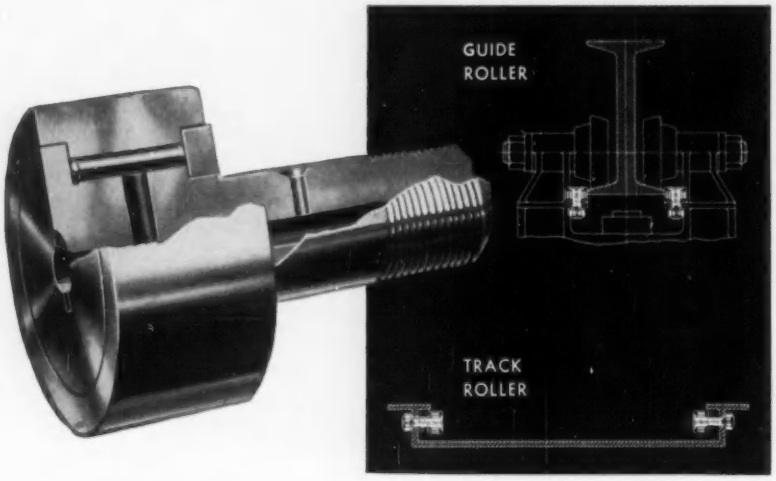
BEARING TIPS by McGill

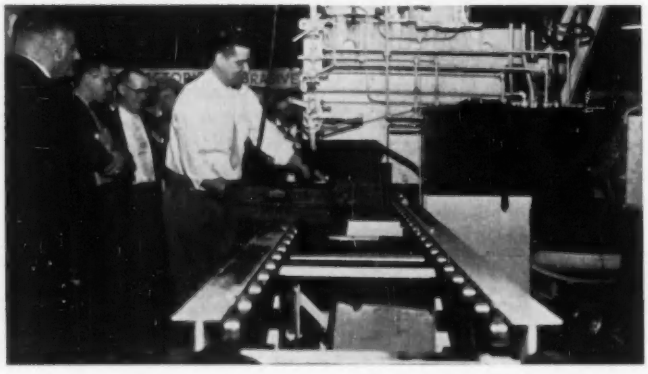
Let a CAMROL® bearing be your guide



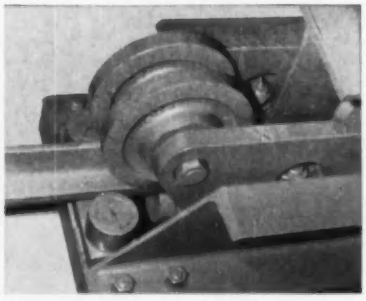
Obtain freer rolling, improved alignment and positive side thrust

In guide and support roller applications CAMROL Cam Followers insure free rolling action and positive side thrust while eliminating the wear of more costly flanged wheels. Then, too, they provide improved alignment and low starting and running friction with high unit load and shock capacity, especially at low speeds as track rollers. Lubrication is simplified and maintenance can be reduced to a minimum in these applications. Specify the interchangeable sealed SGR series for added protection against contamination.

CAMROL® CF bearings provide friction-free track rollers for automatic mold blower



McGill CAMROL CF rollers are used as guide rollers to form a mold conveyor in the Beardsley & Piper MBS-20 Mold Blower. The machine blows and squeezes cope or drag in a single automatic operation, handling up to 4 molds per minute. The CAMROL CF bearings replaced less efficient friction rollers in this application. Although, the duty here is rather light and speeds slow, the cam follower bearing provides lesser starting and running friction. This helps speed the flow of work from the machine, which must be fast and automatic. The integral stud feature eases assembly and its standard design simplifies procurement.



CF bearings minimize maintenance as crane side guide rollers

McGill CF cam follower bearings serve as side guide rollers in overhead cranes manufactured by Louden Machinery Company of Fairfield, Iowa. Freedom from maintenance, a time saver because of the inaccessibility of the bearing when the crane is in operation, is an important advantage of the cam follower bearing.

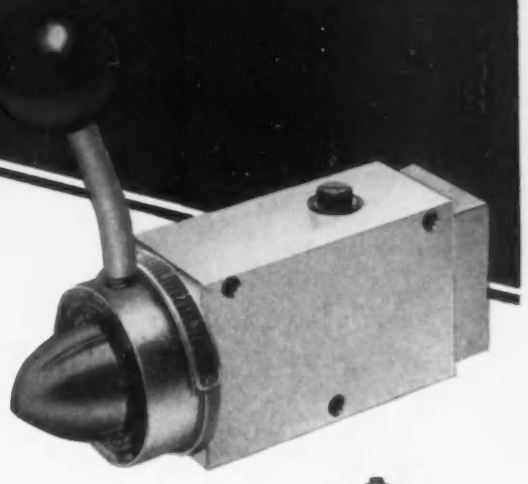
Send for Catalog No. 52-A

Insure performance with McGILL®

MULTIROL® GUIDEROL® CAMROL®
Precision Needle Bearings

McGILL MANUFACTURING COMPANY, INC., 201 N. LAFAYETTE ST., VALPARAISO, INDIANA

For SAFE, DEPENDABLE ENGINEERED for DURABILITY . . . CONTROLS



CONSULT WATERMAN

Waterman controls are known for their accuracy, dependability, safety, and low maintenance cost.

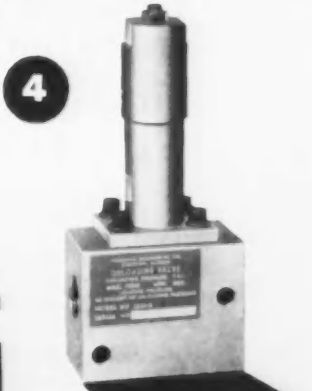
Adjustable Flow Regulators range from 0.5 GPM to 20 GPM. They maintain a constant rate of flow regardless of resistance or pressure fluctuations.

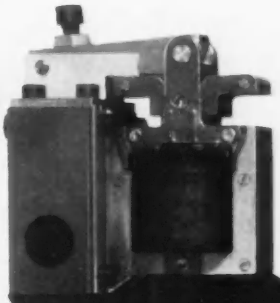
No. 1 Check Valves are one piece, Nylon Poppet, aluminum body and low pressure drop.

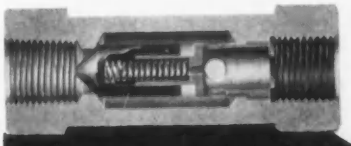
No. 2 Micronic Line Filters have operating pressures to 3000 psi, 40 micron filtration, replaceable elements, and are available in ⅜" and ¾" NPT.

No. 3 Solenoid Valves are inexpensive, compactly built units for hydraulic systems handling non-corrosive fluids. Capable of continuous operation for working pressure to 3000 psi.

No. 4 Unloading Valves for pressures to 3000 psi. Flow rates to 30 GPM. Fast acting, maintain desired pressure without continuous readjustments.







1

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3

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Write for data on any of these WATERMAN products

WATERMAN ENGINEERING COMPANY

725 CUSTER AVENUE — EVANSTON, ILLINOIS

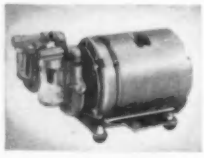
ROTARY AIR
GAST
PRODUCTS

Model 3040 Oil-less Air Pump. Up to 20" vacuum, up to 10 p.s.i. pressure. Capacity to 24 c.f.m.

Provide oil-free air blast with any of the carbon-vane

GAST rotary vane AIR PUMPS

Model 0240, 0440, 0740 Series Oil-less Air Pumps. Three displacements, from 1.9 to 5.6 c.f.m. Vac. to 15", pressure to 10 p.s.i.



Model 0211-P103-G8X Integral-Motor Oil-less. Up to 1.3 c.f.m. Motor 1/6 h.p. Wt. only 22 lbs. Smaller Model 0406 Oil-less has 1/12 h.p.

Need a pump that delivers absolutely *oil-free* compressed air? A Gast Oil-less Air Pump may be your answer! Built in seven different models — vacuum or pressure — these pumps* run *entirely without oil* in the pumping chamber.

Four carbon vanes lubricate themselves. Ball bearings are grease-sealed for life and separated from pumping chamber by a ventilated space. Air flow can't be contaminated with hot oil vapor.

You can *forget* oiling maintenance problems too! Simple construction delivers up to 15,000 hours' operation without attention, depending on r.p.m. and service conditions. This is a big advantage, especially when your product requires a compressor or vacuum pump mounted in a hard-to-service location.

Widely used on food-packaging, paper-handling, folding and laboratory machines.

Write for full details — request Bulletins 152A and VP-356. GAST MANUFACTURING CORP., P.O. Box 117-V Benton Harbor, Michigan.

*Standard oil-lubricated models also available.

SEE CATALOG IN SWEET'S PRODUCT DESIGN FILE

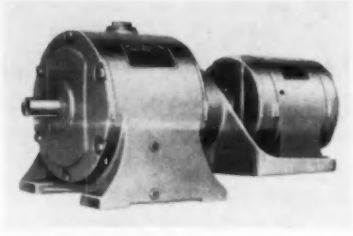
GAST ROTARY

- AIR MOTORS TO 7 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

"Air may be your answer!"

The machine is capable of continuous cycling at any frequency from 0 to 200 cps without flutter. Start time is 3 millisec: stop time has been reduced to 1.5 millisec. A vacuum-loop device in conjunction with the tensioning system provides proper tape tension. Other features are in-line threading, end-of-tape sensing and tape-break protection. Density, up to 47 channels, is obtained with a high-density record/playback head. **Potter Instrument Co., Inc., Sunnyside Blvd., Plainview, N. Y.**

Circle 24, inside back cover



Integral and all-motor gearmotors . . .

ranging from 1 to 60 hp and from 9 to 520 rpm are available for immediate delivery. Gear sets and motor packages are interchangeable in the field without disconnecting the gear motor from its foundation or the driven shaft. Ratio can also be changed in the field when output-speed must be changed. Gear housings are accessible from either end. **Western Gear Corp., P. O. Box 182, Lynwood, Calif.**

Circle 25, inside back cover

Surface alloy for molybdenum . . .

permits use of the metal at working temperatures in excess of 2000 F. Previously, at high temperatures, the metal formed a volatile oxide that eroded and eventually deteriorated. Surface alloying process involves a diffusion of chromium into the surface and provides molybdenum with a high degree of oxidation resistance. Diffusion is uniform on all exposed base-metal surfaces and penetrates all cracks, pores, and recesses. It is said to be easily controlled and reproduced. **Chromalloy Corp., 450 Tarrytown Rd., White Plains, N. Y.**

Circle 26, inside back cover

Timer withstands shock . . .

and vibration without loss of accuracy. Incorporates a runaway-type escapement, powered by a 40-lb spring that, when released by the lanyard pin, also provides impact for firing pin that detonates cartridge. Nitrited steel is used for pinions in the gears, achieving hard surfaces with-

(Continued on page 126)

MOLY NEWS

CLIMAX MOLYBDENUM, 500 FIFTH AVENUE, NEW YORK 36, N. Y.

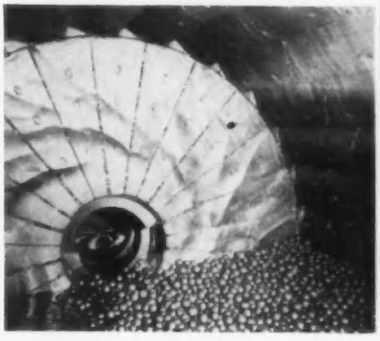
Chrome-Moly Steels Prove Ability To Resist Wear and Abrasion, Cut Costs

Can be Adapted to a Wide Range of Uses

To offset rising equipment and maintenance costs, the savings possible with wear-resistant alloy steels are receiving increasingly wide attention, in a growing number of industries.

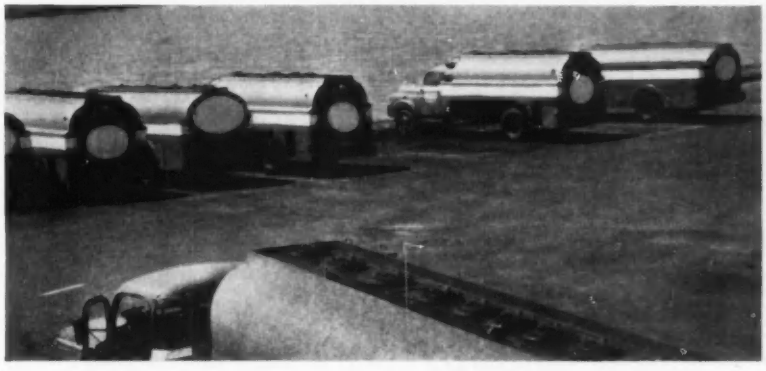
Two types of "Chrome-Moly" steels show exceptional resistance to abrasion and wear under toughest conditions. Both have substantially cut liner costs and shutdown time in grinding mills. Both are suitable for a variety of other industrial applications because they combine wear resistance, favorable first cost, freedom from premature failure by breakage or spalling, resistance to flow in service, consistently uniform performance and adaptability to specific designs.

The two types are Pearlitic (250-450 BHN) and Martensitic (450-700 BHN). Carbon and alloy contents and heat treatments of both types can be varied to suit specific applications.



Note that the spiral wear pattern is clockwise, even though the mill's rotation is counter-clockwise. Type 2 Martensitic steel is used here.

For an article on the use of Chrome-Moly steels, send for "How to Select Chrome-Moly Steels for Ball and Rod Mill Liners" by T. E. Norman, reprinted from Engineering and Mining Journal. Circle #1 on the coupon.



New Use For Super-Strength Structural Steels

Today, gasoline trailer tanks are built of super-strength structural steels for a good reason. The steels have high strength/weight ratios. This factor enables builders to design tanks that carry greater payloads and still meet legal gross weight limits. And the extra capacity pays for the higher trailer cost in a few months!

This use is only one of countless possibilities for utilizing the steels' minimum yield strengths of 55,000 to 150,000 psi . . . and their many other desirable properties. *For more information, including tradenames and compositions, ask for "Super-Strength Structural Steels." Circle #2.*

Sums Up Moly's Resistance to Corrosion

A new paper, "Corrosion Resistance of Molybdenum and Molybdenum-Base Alloys," based on published literature, summarizes moly's resistance to a number of corrosive media. It also lists the reference articles. For a copy of this paper, *circle #6.*

Molybdenum Improves Corrosion Resistance of Stainless Steels

Translated excerpts from two French articles discussing how moly improves the corrosion resistance of austenitic and austenitic-ferritic stainless steels are now available. *Circle #7.*

Special Steels Solve Hydrogen Sulphide Problem

Hydrogen sulphide in France's Lacq natural gas field brought up a metallurgical problem: the need for tubing meeting the N-80 strength requirements but with better resistance to sulphide stress corrosion than the conventional N-80 grade. Two such steels have been developed. One contains chromium, aluminum and molybdenum; the other contains chromium, molybdenum and vanadium.

For articles discussing both steels, send for "A Special N-80 Steel Tubing . . . " by Cauchois, Didier and Herzog, reprinted from *Corrosion*, and "Comments on new French N-80 Steels" published by Climax. *Circle #3.*

Vanadium in Low-Alloy, High-Temperature Steels

Molybdenum is a must in low-alloy, high-temperature steels. However, recent tests at the U.S. Naval Research Laboratory point up the role of Vanadium in such steels, and show the effect of variations in composition and treatment. Addition of Vanadium results in a better high-temperature alloy, but getting the improvement requires higher normalizing temperatures.

The advantages and limitations are described in an *Iron Age article*, "Higher Vanadium Improves Hot Strength of Low Alloy Steel," by Paul Shahinian and J. R. Lane. *For reprints, circle #4.*

New Cleaner Removes Surface Oxides From Moly Metal

A practical, low-temperature method of cleaning molybdenum has recently been developed. It is especially suitable for removing surface oxides prior to welding. The process involves two chemical baths: one at 150-180°F, the other at room temperature. *Digested from "Ryan Devises Molybdenum Cleaner," Ryan Aeronautical Company. For reprints, circle #5.*

Climax Molybdenum, Dept. 61
500 Fifth Avenue, New York 36, N. Y.

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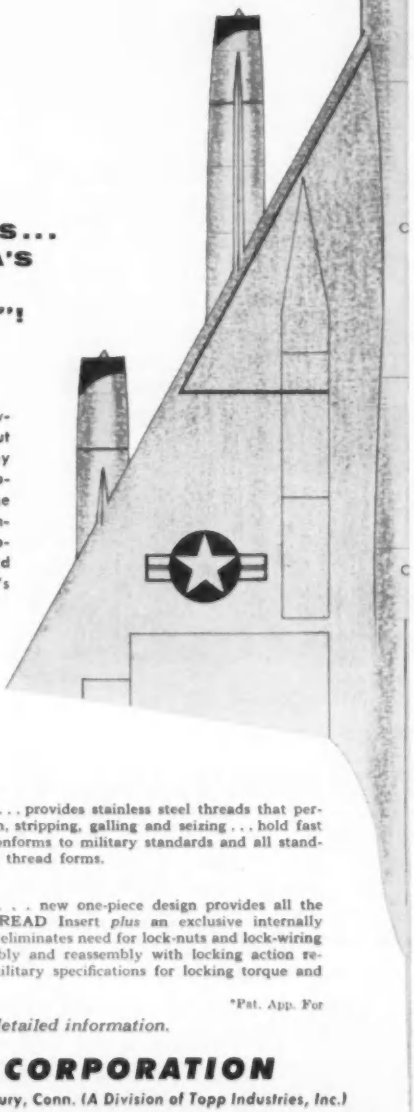
HELI-COIL® INSERTS...
PART OF AMERICA'S SUPERSONIC "SUNDAY PUNCH"!

Heli-Coil Screw-THREAD and Screw-LOCK Inserts are used throughout Convair's B-58 "Hustler". They help combine lightness with exceptional strength and rigidity in the power plant, fuselage, wings, control surfaces and electronic equipment. This adds up to rock-solid structural security for the nation's newest and fastest bomber.



HELI-COIL Screw-THREAD Insert . . . provides stainless steel threads that permanently resist wear, corrosion, stripping, galling and seizing . . . hold fast under vibration and shock. Conforms to military standards and all standard commercial and industrial thread forms.

HELI-COIL Screw-LOCK* Insert . . . new one-piece design provides all the advantages of the Screw-THREAD Insert *plus* an exclusive internally integrated locking feature that eliminates need for lock-nuts and lock-wiring . . . permits repeated disassembly and reassembly with locking action remaining unimpaired. Meets military specifications for locking torque and vibration.

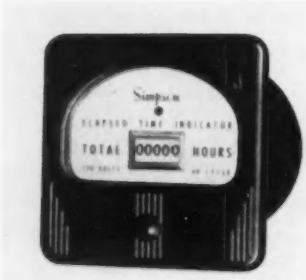
*Pat. App. For

Write for detailed information.

HELI-COIL CORPORATION
602 Shelter Rock Lane, Danbury, Conn. *(A Division of Topp Industries, Inc.)*
In Canada: W. R. WATKINS CO., Ltd., 41 Kipling Ave., S., Toronto 18, Ont.

out brittleness. Closely regulated manufacturing tolerances, and spring-lubrication technique, ensure satisfactory performance under extreme temperature conditions and acceleration to 75 g. **Technical Oil Tool Corp., 1057 N. La Brea Ave., Los Angeles 38.**

Circle 27, inside back cover



Elapsed-time indicators . . .

built around a self-starting, synchronous-clock motor, are made for either 120 or 240 v. Available in 3½-in.-round, 3½-in.-round-shroud and 3½-in.-rectangular cases. The latter is carried in stock; the others are sold on special order. Instruments contain automatic-resetting counters reading either 0-99999 or 0-999.9 hr. **Simpson Electric Co., 5200 W. Kinzie St., Chicago 44.**

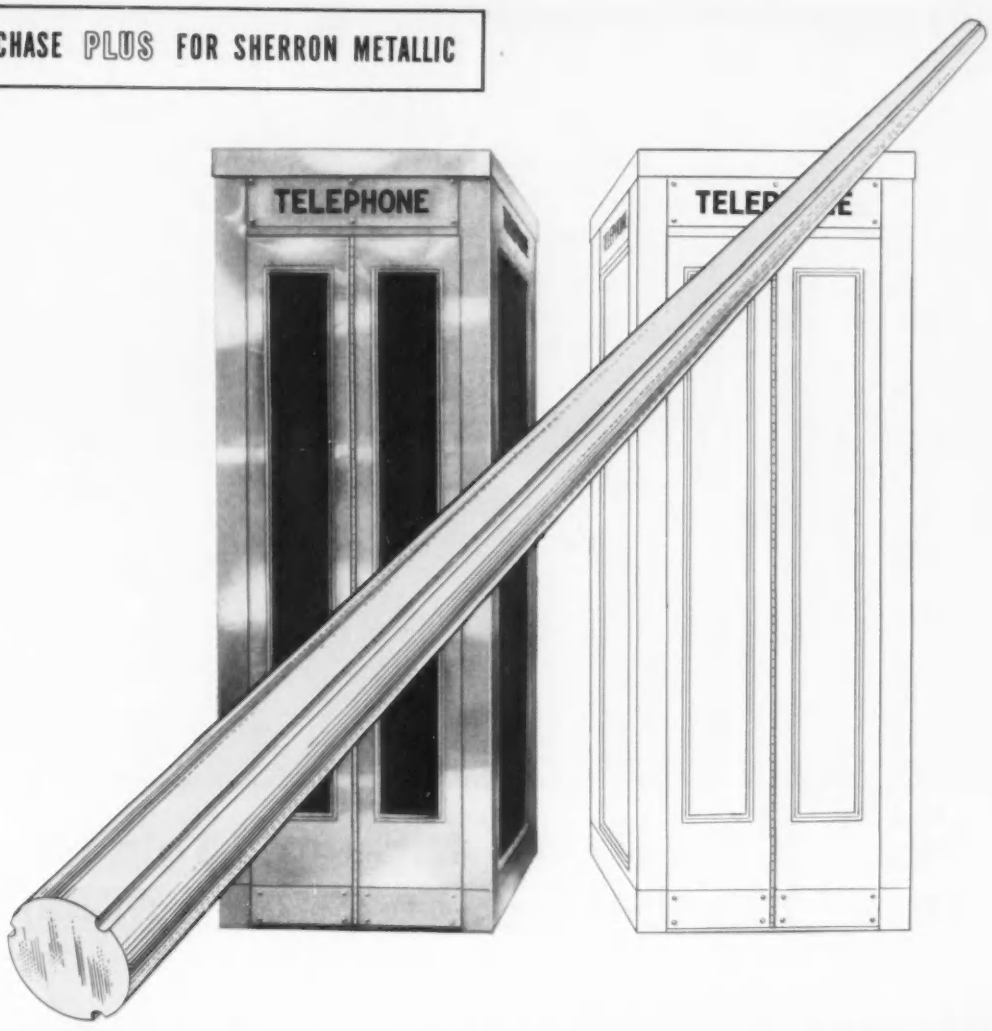
Circle 28, inside back cover

High-temperature relay . . .

has high shock and vibration resistance. SPDT relay operates on 40 milliw under shocks of 30 g and vibrations of 10 g to 500 cps. Where high shock and vibration resistance is not required, it will operate on 25 milliw. Will operate on current to 6 amp and voltages to 115 v dc.

(Continued on page 130)

THE CHASE PLUS FOR SHERRON METALLIC



Permanent "*silencers*" for noisy phone booth doors

Largest independent maker of telephone booths, Sherron Metallic Corporation came to Chase Brass engineers with a problem. They wanted a 76" long hinge pin for doors on their all-metal outdoor-indoor booths, a pin that had to resist extremes of heat and cold, operate without squeaks, never corrode or bind.

Working with CHASE, Sherron designed a special brass shape with lengthwise grooves, machined to extremely close tolerances. These grooves are packed with a special all-weather lubricant. Installed in the Sherron booth, they give lifetime service without further maintenance.

CHASE engineering can help you solve a problem—either by designing special shapes like this one, or by choosing the *right* alloy for your needs in strip, sheet, rod, tube, or wire by CHASE of Kennecott Copper. Talk over the details of your own specific problem with CHASE—either locally or at Waterbury 20, Connecticut.

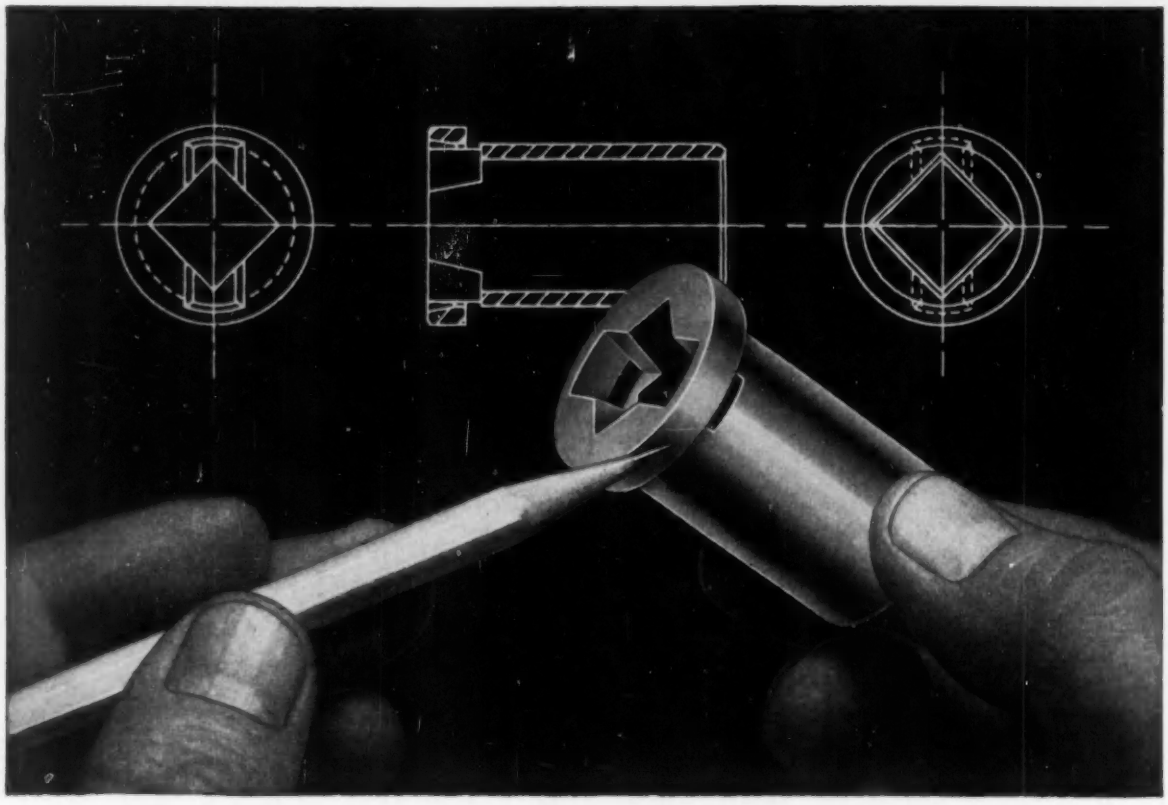
You can get the right alloy from ... Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L.I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury



How Would YOU Produce This Part With No Machining . . . No Scrap Metal?

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R. W. Fletcher • Loomis Avenue
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Can't be done? Parker did it . . . sharp internal corners, lateral holes, chamfers, flanged end and all . . . by fast, low-cost powdered metal pressing and sintering. No subsequent machining . . . no scrap-metal loss. Just think of the savings compared with conventional machining methods.

In addition to these inherent cost savings, Parker-engineered Powdered Metal Parts offer a wide choice of tensiles, ductility, density, impact resistance and other physicals. Tooling-up is done quickly and at relatively low cost.

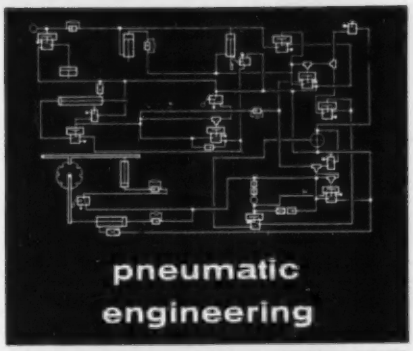
It will pay you to check on the economies and design possibilities of Parker-engineered Powdered Metal Parts. Just call the nearest sales engineer listed here or write the factory direct.

Parker White Metal Company • 2153 McKinley Ave., Erie, Pennsylvania

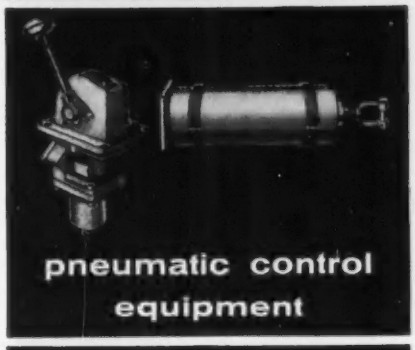
PARKER

high pressure ALUMINUM and ZINC die castings POWDERED METAL PARTS

Get them all from one reliable source!



pneumatic engineering



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GOOD DELIVERY, GOOD SERVICE—From Westinghouse you get distributor service and complete engineering service anywhere in the world—from Westinghouse or its affiliates overseas. Send coupon for more information.

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FREE PNEUMATIC CONTROL DATA—This new booklet covers the basic fundamentals of pneumatic control engineering, based on Westinghouse's 89 years of work in this field.

Westinghouse Air Brake Company
Industrial Products Division, Dept. PE-28
Wilmerding, Pennsylvania

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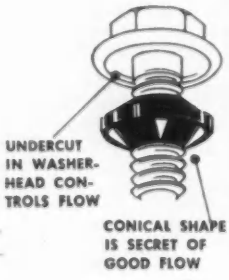
Townsend Tuff Tites® do both jobs well...

One of the outstanding advantages of Townsend Tuff Tite fasteners is that they provide an economical means for leakproof joining of metal, asbestos, porcelain or plastic. The pre-assembled conical neoprene washers flow into the holes as the fasteners are seated, filling them and making waterproof seals. Tuff Tites are effective for any application requiring leakproof joints, such as those needed in the construction or appliance industries.

Tuff Tite advantages include ease and economy of installation, surface protection and vibration resistance. Standard items are immediately available from jobbers and warehouses. Tuff Tites are also available in numerous special designs to suit any application need.

If you are joining metal, plastic, porcelain or asbestos, you should know about Townsend Tuff Tites. Your Townsend representative will be glad to discuss them with you, or we will send you complete literature. Townsend Company, P. O. Box 237-D, New Brighton, Pa.



The Fastening Authority

Townsend

COMPANY • ESTABLISHED 1816

[illegible], Pennsylvania

Sales Offices in Principal Cities

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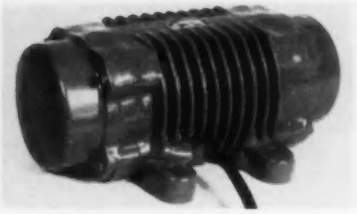
In Canada: *Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario*

Can be supplied with 7-pin miniature plug-in headers for tube-socket or printed-circuit mounting or with pierced-solder lugs and brackets for flange mounting above or below chassis. May be mounted in any position without affecting shock and vibration resistance. **Potter & Brumfield, Inc., Princeton, Ind.**

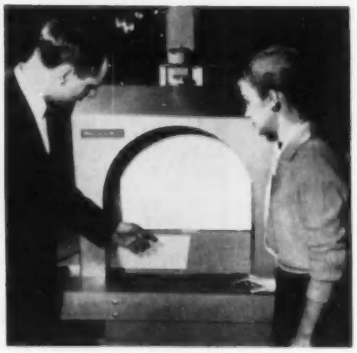
Circle 29, inside back cover



Electric vibrators . . .

are available with a swinging base for concentrated reciprocal vibration or with a rigid base when vibration in all directions is desired. Amplitude or impact is adjustable on all sizes by an eccentric disk. Twelve positions make accurate settings possible. Housing comes with cooling fins to dissipate heat. Glass-insulated windings are standard. Available in $\frac{1}{6}$, $\frac{1}{3}$, 1, $1\frac{1}{2}$ and 2-hp sizes. **Hydrotile Machinery Co., Nashua, Iowa.**

Circle 30, inside back cover



Reproduction of microfilm . . .

engineering drawings can now be made on a microfilm reader-enlarger-processor. Developed specifically for tabulating cards containing 35-mm film in aperatures. Also for use with either roll film or acetate jackets in either 16-mm or 35-mm size. Provides for opaque visual reference to filmed drawings, enlarging them to 17 by 22 in. on reading table. If one or more prints are desired, viewing table is swung away and conveyor-belt system beneath is put into action to bring a sheet of sensitized photographic copy paper into position. Can also use translucent intermediate paper for further reproduction on spirit, diazo or blueprint machines. After

(Continued on page 132)

Readin', 'Ritin', and Reliability

Synthane plastic laminated bushings and breaker arms for automotive ignition.

Dependable operation of a school bus, a truck, or your own car involves the functioning of many parts. One breakdown can wipe out the memory of ten thousand trouble-free miles.

Some of these parts are made of laminated plastics. They're usually unseen, unsung, small in size yet efficiently performing their job.

Their cost is relatively insignificant when compared with the cost of equipment in which they work, but it should be sufficient to insure dependability.

Actually, what you pay for Synthane laminated plastics is little or no more than you'd pay for any other plastic laminate. But the Synthane price includes top quality materials, product control, excellent facilities and workmanship, an assurance of continuous supply, and a long reputation for fair dealing.

If you are interested in a reliable source of laminated plastics—sheets, rods, tubes, or completely fabricated parts, write for an interesting catalog or call our representative nearest you.

SYNTHANE

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The Answer to Your SEALING PROBLEMS in the Palm of Your Hand

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. . . an engineered rotary mechanical seal that is made to meet YOUR SPECIFIC SEALING NEED using selected alloys, carbons and ceramics.

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Send your sealing problems to us for free counsel

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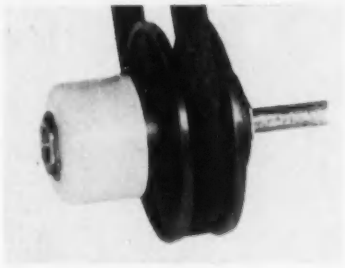
KALAMAZOO MICHIGAN

exposure, sheet is carried through a processing section and emerges damp-dry within 50 sec after exposure. Subsequent prints can be produced at 50 sec intervals. Priced at less than $5000. **Remington Rand, 315 Fourth Ave., New York 10.**

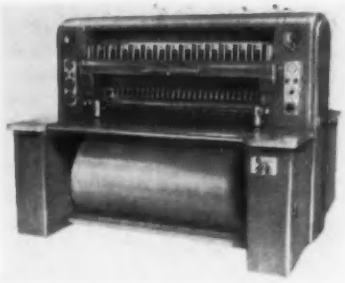
Circle 31, inside back cover



Self-lubricating pulley . . .

for fhp motors has a 2.45:1 speed range, spring-loaded tension, and ½ and ⅝-in. shaft bores. Provides variable speed range for ½ and ⅝-in. V-belt drives. Dia of the nylon-impregnated fiberglass pulley is 3¼ in. Typical applications include appliances, light machinery, business machines and other variable-speed equipment to ½ hp. **Rampe Mfg. Co., 14915 Woodworth Ave., Cleveland 10.**

Circle 32, inside back cover



Elliptical developing tank . . .

on new 54-in. ammonia-developing, diazo-type-processing machine results in printing and developing speeds to 125 fpm. The sensitized material travels around developing tank. Prints are delivered face up, permitting a continuous quality check. Long tracings, automatically roll up without core or spindle. A retractable motor-driven turret handles three 500-yd rolls of material, four 300-yd rolls, or five rolls of 100 yds. Individual rolls are brought into feed position by pushbutton control. Shade control permits two operators to work at the same feed board, printing materials to 24 in. wide with separate timing of two materials. Constructed in

(Continued on page 134)

Model HL-195 Viking Pump
Operates at 1800 RPM

How VIKING PUMPS help de-ice planes

Units built by Pitman Manufacturing Company, Kansas City, Missouri, are helping the U. S. Air Force answer the problem of de-icing, defrosting and de-contaminating parked aircraft. An integral part of each unit is a Viking HL-195 Pump. Positive action of pump delivers fluids to 50-foot high platform, under pressure of 100 psi, for spraying planes.

If you have the problem of lifting liquids under pressure, better investigate Viking Pumps.

For information, see your nearby distributor or write for bulletin 585X.

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps

See Our Catalog in Sweet's Product Design File

Westinghouse CYPAK takes the "mix up" out of cake mix storage conveyors

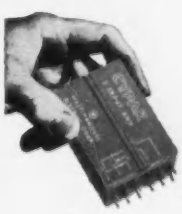
Chelsea Milling Company, maker of well-known "Jiffy" brand premixed foods, uses flexible Cypak* static control to reduce materials-handling costs at its plant in Chelsea, Mich.

Starting at the mixing and packaging machines, Cypak control memorizes the sequence of cartons going to the warehouse . . . maintains carton identification automatically . . . directs storage according to the preselected pattern. In addition, Cypak predetermines subsequent delivery to the loading dock.

Result: substantial savings have been realized through reduced handling and carton breakage.

For complete information on Cypak, call your Westinghouse representative. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pennsylvania.

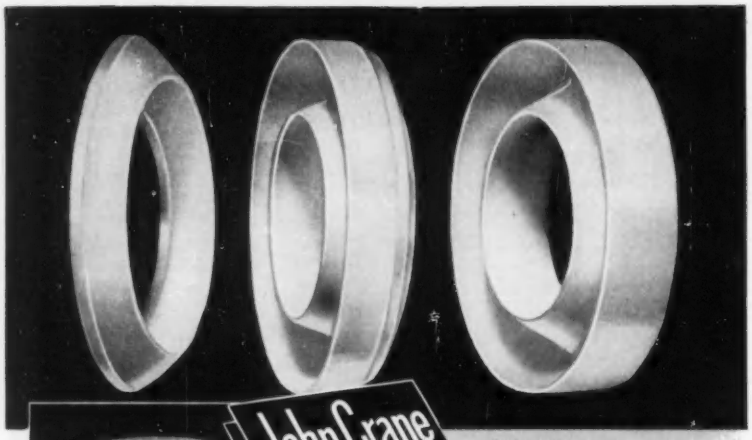
J-22094



*Trade-Mark

POWER-UP starts with CONTROL

YOU CAN BE SURE...IF IT'S Westinghouse



John Crane

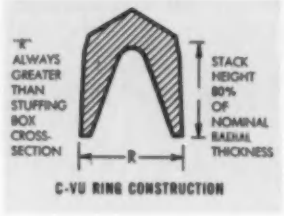
CHEMLON *

C-V RINGS

ARE INDUSTRY'S MOST UNIVERSAL PACKING . . .

Countless successful applications of C-V Rings under the most severe service conditions have made this the closest approach to a universal packing.

It will effectively handle all industrial acids, alkalis, solvents, organic and hydraulic fluids . . . temperatures from −120°F. to +500°F. . . . is equally suited to valves, pumps, mixers, hydraulic cylinders and like equipment.

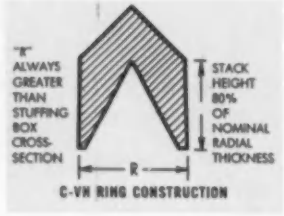


C-VU RING CONSTRUCTION

"John Crane" C-V Rings have extremely low coefficient of friction. "Breakout" friction is only slightly higher than running friction.

TWO STYLES ARE AVAILABLE:

C-VU RINGS *for low pressure service* —such as control and regulator valves handling gases and fluids, where it is necessary to have a very sensitive and resilient type packing.



C-VH RING CONSTRUCTION

C-VH RINGS *for high pressure service* —for use in pumps, hydraulic cylinders and like services at pressures ranging to 500 psi. and over. These rings are constructed with a heavy wall heel to withstand pressure requirements. They are designed to provide voids between rings, so that as the Teflon expands due to heat, this take-up room minimizes any excess friction in the stuffing box.

"John Crane" C-V Rings are available in full line of standard sizes and male and female adaptors. Sizes can be molded to stuffing box specifications.

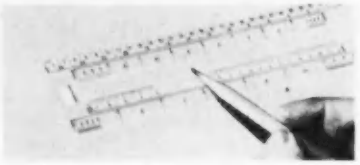
Request Bulletin P-325.

*"John Crane" C-V Rings are made from Chemlon—*the best in DuPont Teflon.*

Crane Packing Co., 6445 Oakton St., Morton Grove, Ill. (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

three sections that permit ready access to all parts of machine. Made of aluminum castings over an iron frame. Over-all dimensions are 94⅜ by 71¼ by 87¾ in. deep. Operates on 220 v, single-phase, 60 cps, 90 amp. Price is $15,000 FOB Holyoke. **Technifax Corp., 195 Appleton St., Holyoke, Mass.**

Circle 33, inside back cover



Eight scales . . .

are printed on a single side of this crystal-clear acrylic ruler. Scales have been laid out side by side each scale has its own straightedge, calibrated to professional standards. The 6-in. leather-sheathed pocket model is $2.25; the unsheathed 12-in. desk scale is $3. Both carry graduations of ¼, ½, ⅛, ¾, ½, 1, 1½ and 3 in. to the foot. **A. Lawrence Karp., 16 Putnam Park, Greenwich, Conn.**

Circle 34, inside back cover

Rate switch . . .

is externally adjustable and can be supplied in ranges of 1 to 10° per sec; 5 to 50° per sec; 10 to 500° per sec. The rate switch is a specialized type of gyro that operates a switch when a predetermined rate of turn is reached. Model RS03-0101-1, now in production, has a rate range from 10 to 200° per sec. Natural frequency is greater than 30 cps. Unit operates on 400 cps, 115 v single-phase power. Gyro contacts operate relays powered by built-in rectifiers. Output relays are SPDT. Contact rating is 2.5 amp. Accuracy is within 10° per sec of selected rate or may be adjusted within approximately 1%, if calibrated on rate table for each adjustment. Operates within temperatures of −65 to 165 F. Withstands acceleration of 40 g; shock of 40 g for 5 millisec and vibration of ±10 g to 500 cps. Weighs about 16 oz. Service life is 500 hr. **Humphrey, Inc., 2805 Canon St., San Diego 6.**

Circle 35, inside back cover

You don't have to be over 21

to install and maintain

a Fenwal temperature indicating controller

It really is a cinch for an untrained person to install and maintain Fenwal's 541 Temperature Indicator Controller. You don't even have to open the case to adjust it — even its snap switches can be easily replaced without disturbing the internal mechanism. *It's simple!*

In Fenwal's 541 all moving parts are in opposition — wear on one is automatically compensated for and the controller's high accuracy remains unchanged! *It's reliable!*

You can take your choice of temperature range, bulb styles, and one or two circuit controls, current ratings — even the color of the housing. There are literally hundreds of adaptations that can be made from stock! So you get a tailor-made, fit-to-order controller at a competitive price! *It's versatile!*

Drop us a line at Fenwal Incorporated, 22 Pleasant Street, Ashland, Mass. and we'll send you our catalog MC-139 or our sales engineer, whichever you want.

This is our dual circuit model (we've got hundreds of others) which has two snap switches, each with a set point indicator, that actuates two circuits at pre-set temperatures. Housing in all Fenwal 541's meet NEMA and JIC specifications.

Fenwal CONTROLS TEMPERATURE . . . PRECISELY

PROOF that you can

RELY on GI

Fractional H. P. Motors

1/40 H. P. to 1/1100 H. P.

Meet an all-around performance champion. GI's husky, versatile Model "A" motor. Proved dependable millions of times over, it's the power choice of the nation's great-name manufacturers . . . setting an amazing performance record in countless applications from phonographs to kitchen fans to pumps. If dependability is your aim, Model "A"is your motor!

MODEL"A" two-pole shaded pole motor available in various lamination thicknesses. Precision constructed for reliable, long hard usage. Perfectly balanced for smooth, quiet, operation.

Write for quantity price quotations today!

SPECIFICATIONS

MODEL	HP 2800 RPM	Locked Torque In/Oz	Max. Running Torque In/Oz	Rotor Free Speed RPM	A
A-3-CW A-3-CCW	1/500	0.70	1.1	3360	3/8"
A-5-CW A-5-CCW	1/180	1.7	2.7	3430	5/8"
A-6-CW A-6-CCW	1/130	1.9	3.3	3430	3/4"
A-7-CW A-7-CCW	1/100	2.1	3.8	3500	7/8"
A-8-CW A-8-CCW	1/90	2.5	4.5	3480	1"
A-9-CW A-9-CCW	1/70	2.7	5.3	3520	1 1/8"
A-12-CW A-12-CCW	1/60	3.0	6.5	3500	1 1/2"
A-14-CW A-14-CCW	1/50	3.1	7.0	3490	1 3/4"

Standard shaft diameter .1817, 1/4" shaft available if desired.

THE GENERAL INDUSTRIES CO.

DEPARTMENT GK • ELYRIA, OHIO

CATALOGS and BULLETINS

To obtain copies of literature described below, circle corresponding number on postcard inside back cover. For those catalogs and bulletins available only when requested on company letterhead, see page 142

VALVES—Catalog 58-59, 56 pp. Characteristics and other data to aid in selection of valves. With cross-sections, graphs to determine how to calculate pressure drop, discharge and velocity of liquids, and pressure conversion chart scaled from O to 3000 psi. One section summarizes probable causes and remedies for more difficult maintenance problems, with maintenance suggestions. Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58.

Circle 36, inside back cover

MECHANICAL POWER-TRANSMISSION AND CONVEYING MACHINERY—Catalog 610, 304 pp. Descriptions, specs application and selection data on products for power-transmission, conveying and elevating service. Lists chain for most power transmission, timing, tension and conveying applications. Two pages of basic selection data included. Thumb-cut indexed. Chain Belt Co., Sales Promotion Dept., Milwaukee 1.

Circle 37, inside back cover

MANUALLY OPERATED, FOUR-WAY HYDRAULIC VALVES—Section 210, 12 pp. Describes pipe-connected, flange-connected and subplate-mounted valves with specs pertaining to each shown with a cross-section view of each model. Also, ordering instructions, optional features and graphs of flow vs pressure drop. Rivett, Inc., Brighton 35, Boston.

Circle 38, inside back cover

TESTING INSTRUMENTS—Catalog 58, 12 pp. Contains brief descriptions and illustrations of 50 units, which include testing and calibration instruments. Custom Scientific Instruments, Inc., Kearney, N. J.

Circle 39, inside back cover

REINFORCED MOLDING COMPOUNDS—Catalog, 40 pp. Has data sheets on each of seven reinforced-polyester molding compounds. Form and shelf life are given, as well as physical, chemical, mechanical and heat-resistant properties of the molded part under ASTM procedures. With recommendations on molding conditions. A selector chart is included. Also, instructions on storage and handling, die selection and design. Atlas Powder Co., Chemicals Div., Wilmington 99.

Circle 40, inside back cover

FASTENERS—Catalog 8-416, 12 pp. Covers fasteners, blind rivets and driving tools, design, specs and uses. Driving cycle for each fastener is illustrated. Tools are briefly discussed. Typical commercial applications are shown. Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7.

Circle 41, inside back cover

SOLID FILM LUBRICATION—Bulletin 2049, 4 pp. Includes data on wear life vs load at various speeds, friction and physical properties and data on fluid immersion tests. Electrofilm, Inc., P.O. Box 106, N. Hollywood, Calif.

Circle 42, inside back cover

PATTERN MAKING—Booklet, 12 pp. Wood and metal-pattern development is described and profusely illustrated. Also, methods for developing plastic patterns and molds for short-run use. Motor Patterns Co., 3035 E. 61st St., Cleveland 27.

Circle 43, inside back cover

QUARTER-TURN FASTENERS—Catalog, 24 pp. Describes three separate lines of quick fasteners. Dimensional data, comprehensive installation and application information is included. Completely illustrated with product pictures, applications and dimensional drawings. Fastex Div., Illinois Tool Works, 195 Algonquin Rd., Des Plaines, Ill.

Circle 44, inside back cover

FLUID-FLOW-RATE ALARMS — Bulletin 165, 4 pp. Alarms for signaling or simple control functions are described. Magnetic or electronic types are available. Specs and operating details are given. With schematics. Brooks Rotameter Co., Lansdale, Penna.

Circle 45, inside back cover

SHAFT-RETENTION FASTENERS — Booklet, 8 pp. Describes and illustrates line, explains pilot-tooth design. Includes dimensional data, specs and application information. Fastex Div., Illinois Tool Works, 195 Algonquin Rd., Des Plaines, Ill.

Circle 46, inside back cover

MACHINERY MOUNTINGS—Bulletin K3B, 4 pp. Eight case histories, with installation photos. Data tables give capaci-

(Continued on page 139)

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World's Largest Selection of

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LUBRIKIT . . . An assortment of 95 oil cups of 29 different types. Gits sales records show these oilers are most used for replacement and maintenance. Contents of each separate bin are clearly described on Inside Cover.

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OIL HOLE COVERS

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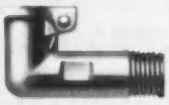
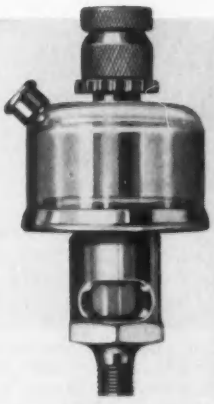
Ball Valve



Style L — No. 1204
Brass Elbow (Threaded)

SIGHT GRAVITY FEED OILERS

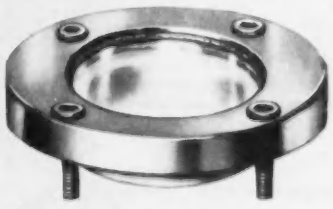


Rate of oil flow regulated by needle valve, directly observed through sight glass in stem. Shut-off knob does not affect needle valve adjustment. Visible oil supply. Non-breakable. Tops in convenience and dependability, at low cost. Style NFU—No. 3602-A.

GEAR CASE GAUGES

This oil gauge plug permits instant checking of oil level within a transmission or gear case. For use where construction permits insertion in tapped hole. A valuable addition to any such equipment — at very low cost. Style BW—No. 4042.

GEAR CASE GAUGES



Screw mounted, to set flush. Glass port is backed with white enameled reflector, to make oil level (in gear case or transmission) readily visible, even in dim light. Style CW — No. 4032.

SIGHT GAUGES

For use where rate of oil flow must be regulated to suit changing operating conditions. Needle valve permits extremely accurate adjustment of oil feed. Sight glass provides direct observation of rate of oil flow. Accuracy and convenience at a moderate price. Style PF—No. 4290.

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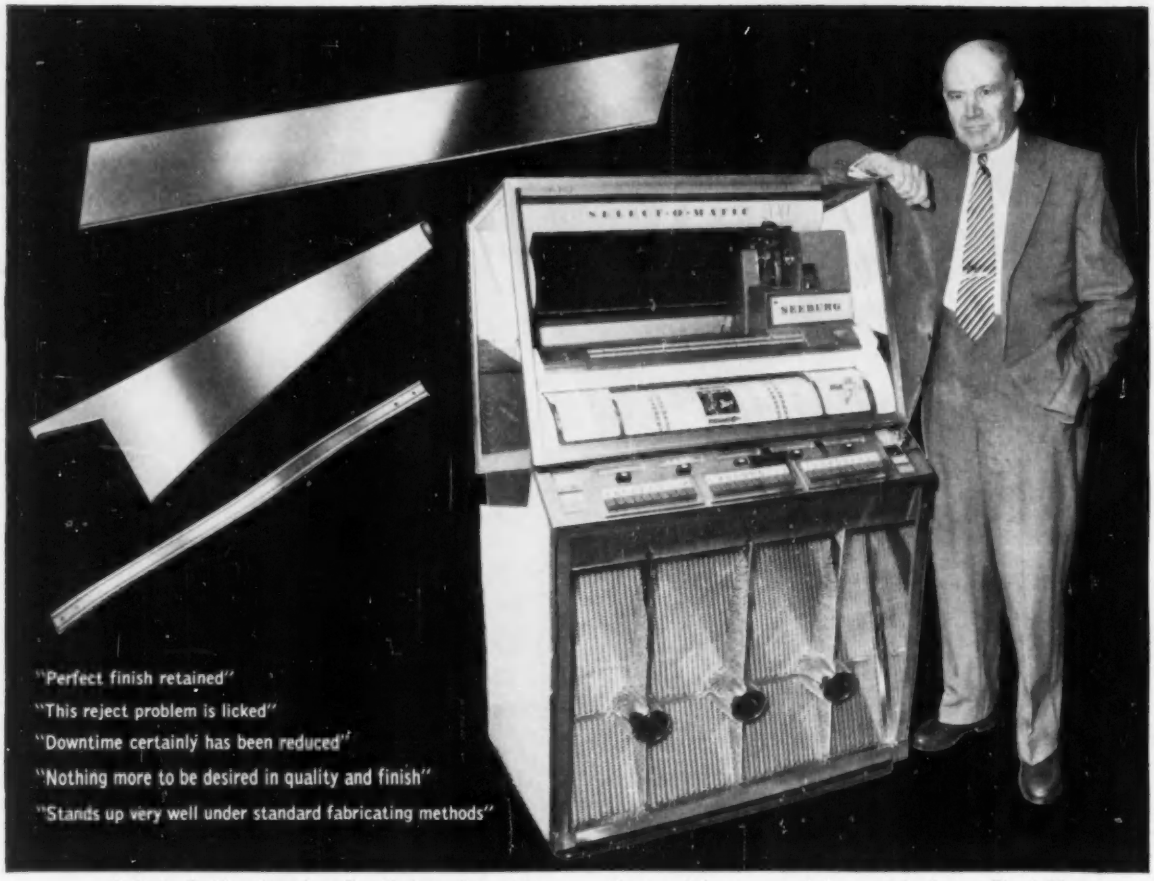
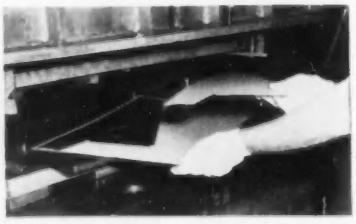
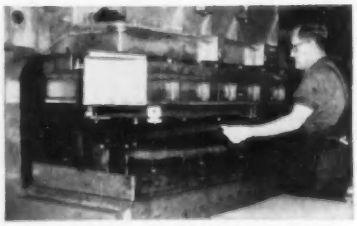

"Perfect finish retained"
"This reject problem is licked"
"Downtime certainly has been reduced"
"Nothing more to be desired in quality and finish"
"Stands up very well under standard fabricating methods"

K. R. Craft, Vice President, The Seeburg Corp., Chicago, with one of the company's famous juke boxes. The brilliant reflectivity and durability of Nickeloid pre-plated metals is an important factor in the product's eye-catching good looks.

NICKELOID METALS SAVE 4 PRODUCTION STEPS— REDUCE REJECTS FOR THE SEEBURG CORPORATION



Standard fabricating methods are used to stamp and form juke box trim. Nickeloid Metals eliminate machinery tie-up; rejects are less than 1%.



Stamping Nickeloid chrome steel, protected with Mar-Not adhesive-backed paper which is easily peeled off. Finished part will need no polishing.

Pre-Finished Design Material is Easily Worked With Standard Fabricating Methods

The Seeburg Corporation uses Nickeloid *pre-plated* chrome steel to achieve functional beauty and attention-value . . . economically. Before switching to Nickeloid, the company did its own cleaning, plating and buffing. The job required four — sometimes five more operations than are now necessary. According to Mr. Craft, "The tremendous cost of plating and buffing was not only more expensive and much more time consuming, but the finished product had to be inspected, and the rejections on plated and buffed metals was very much higher than it is with Nickeloid. Economically, the Nickeloid Metals have proved themselves in production."

Using standard fabricating methods, Nickeloid Metals need only be stamped and formed — then assembled. By capitalizing on this pre finished *method* of production, this leading manufacturer has eliminated the machinery formerly required for plating, polishing and buffing — saved four or five production steps, and is producing a better end product *with less manpower*. Can you use these advantages in *your* operation?

14 finish-to-base metal combinations — sheets, coils, strips.

WRITE TODAY FOR FREE LITERATURE

NICKELOID METALS SINCE 1898

AMERICAN NICKELOID COMPANY
PERU 4, ILLINOIS

ties, characteristics, sizes, load capacities, dimensions and shipping weights. Korfund Co., Inc., 48-19C 32nd Pl., Long Island City, N. Y.

Circle 47, inside back cover

SELF-TIGHTENING HOSE CLAMP—Brochure, 6 pp. Sizes and specs of hose clamp are given. New feature is described and discussed. Corbin Hose Clamp Div., American Hardware Corp., New Britain, Conn.

Circle 48, inside back cover

ROTARY POSITIVE-DISPLACEMENT PUMPS—Bulletin TLP-57, 12 pp. Operating characteristics, with emphasis on a cosine-rotor development design. Provides analysis of performance, graphs on operating speeds and ranges, corrosion resistance charts, data on seals and specifications for determining pump size, speed and horsepower. GTA Library, Manton-Gaulin, 44 Garden St., Everett 49, Mass.

Circle 49, inside back cover

AUTOMATIC CONTROLS—Catalog, 36 pp. Groups together a selection of automatic controls commonly used in designing automatic systems. Included are counting devices, switches, electric valves, actuators, relays, limit controls, time switches and accessory equipment. Gives specs, application information and descriptions. General Controls Co., 801 Allen Ave., Glendale 1, Calif.

Circle 50, inside back cover

MOLDED-PLASTIC BLOWER WHEELS—Catalog sheets for each dia, 44 pp each. Describes one-piece nonmetallic blower wheels available in 5⅛, 6⅛, 7⅛ and 8 in. dia. Description, specs, performance curves and dimensional draw-

(Continued on page 142)

"It's not that your work isn't satisfactory, Miller; we just don't like you!"

Shaking for cocktails is a must — but certainly not indicated in your automobile. And that's just what you would get — king-size shaking and vibrating if your car were not equipped with washers that are designed to counteract the natural forces of friction and vibration with consequent looseness.

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  - ☐ SAW TOOTH WASHERS
  - ☐ HOSE CLAMPS
  - ☐ STAMPINGS
  - ☐ STATISTICAL QUALITY CONTROL

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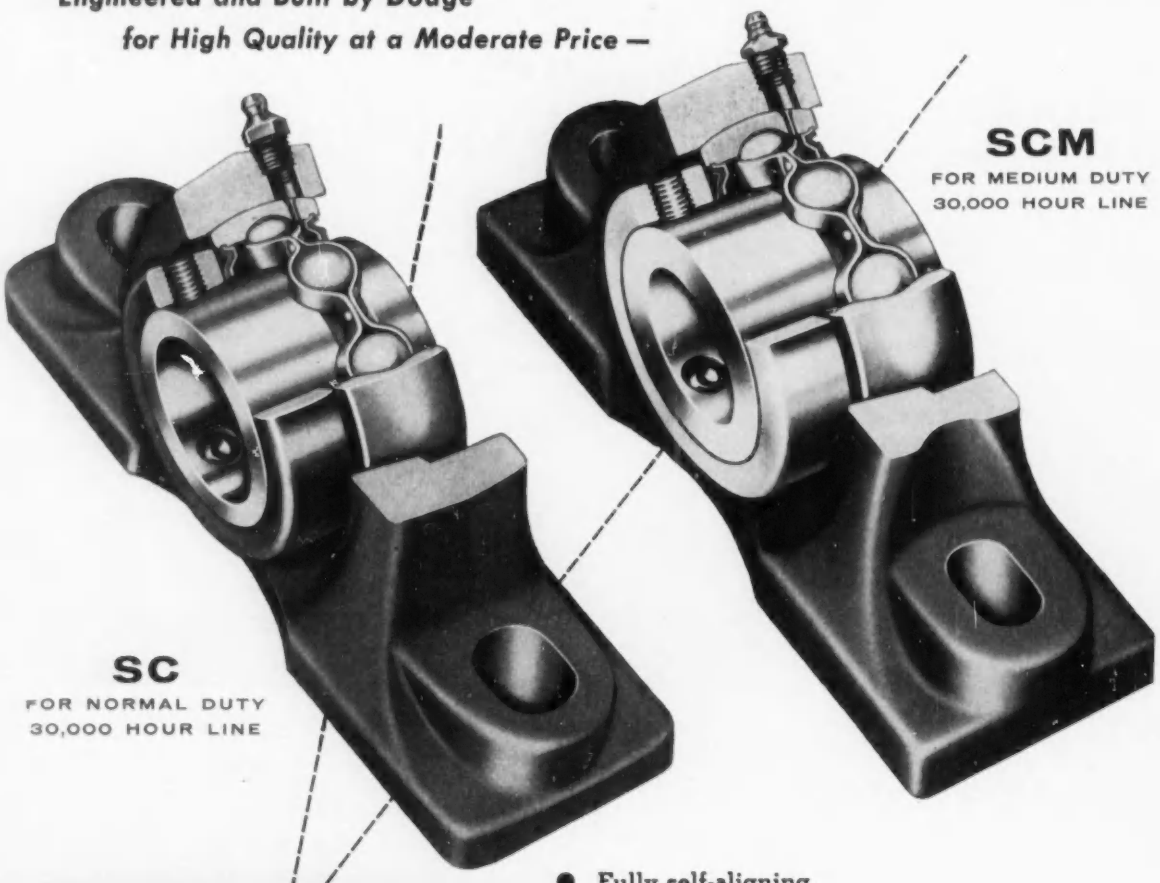
PE 258

Engineered and Built by Dodge
for High Quality at a Moderate Price —



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- Available from distributor stocks—SC in shaft sizes from 3/4" to 2-7/16"; SCM from 1-7/16" to 3-7/16".
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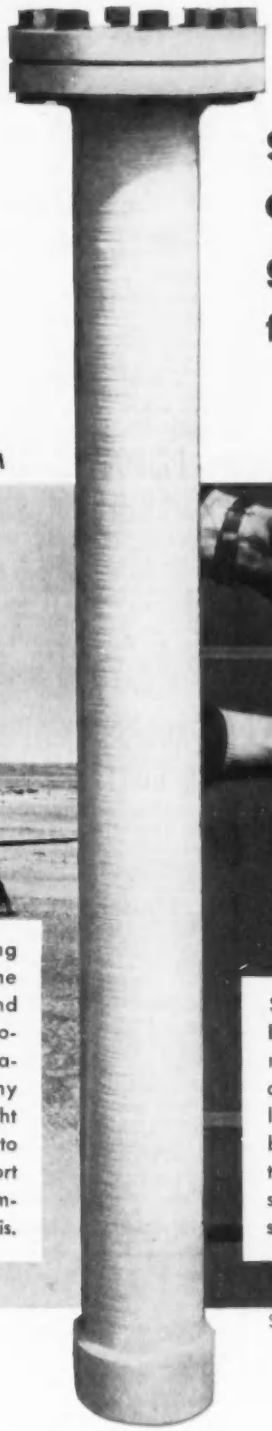
IDEAS IN THE MAKING WITH
CIBA ARALDITE EPOXY RESINS

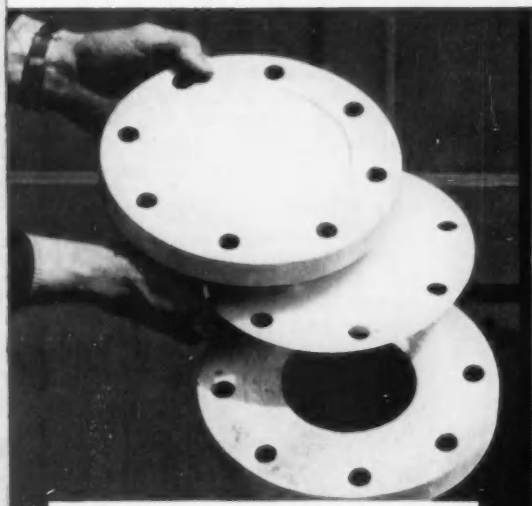


SHIPPING TUBES manufactured with CIBA Araldite® Epoxy resins and glass get to the "core" of a problem for major petroleum producer.

THE PROBLEM

Between drilling locations in the Middle East and geological laboratories in Oklahoma are many costly air-freight miles over which to speedily transport heavy core samples for analysis.

THE SOLUTION



Shipping tubes like this made of Araldite Epoxy and glass weighing only 17½ pounds now replace 300 pound steel tubes. Not only do the Epoxy-glass tubes provide the light-weight strength with safety required but also provide the necessary non-contamination without special coating so that sample liquids could be shipped with core samples.

THE RESULT

Core samples and liquids are now flown in from all the far-flung drilling locations of a major oil company at a 1 to 17 saving in air-freight costs.

Shipping Tubes produced by Ed Conley Plastic Corp., Tulsa, Oklahoma.

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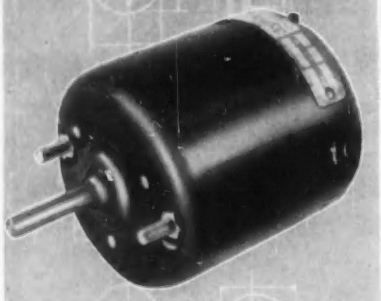

Junction Box Welded to Case

Elkey Connector

TYPE D INDUCTION MOTOR for trouble-free performance

This 2-pole shaded pole induction motor has a free speed of approximately 3400 rpm, with recommended load speeds of 3000 and 3100 rpm. Available for 115 V AC, 60 cycle operation, CW or CCW rotation.

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Heinze motors are also designed to your exact specifications. Write Dept. F for free catalog.

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SUB-FRACTIONAL HORSEPOWER MOTORS AND BLOWERS

Catalogs and Bulletins.....continued

ings. Denbo Engineering & Sales Co., 3301 Martindale Ave., Indianapolis 18.

Circle 51, inside back cover

ACCELERATION TEST MACHINE—Bulletin S-1, 6 pp. Describes G-testing, as required by MIL-E-5272A, including models available, performance specs, operational-performance features. With cutaway illustration. Rucker Co., 4734 San Pablo Ave., Oakland, Calif.

Circle 52, inside back cover

LARGE INDUCTION MOTORS—Bulletin 1950, 16 pp. Presents line of motors in ratings from 150 to 1250 hp. Cutaway drawings and illustrations. Optional features also described. Louis Allis Co., 427 E. Stewart St., Milwaukee 1.

Circle 53, inside back cover

INDEXING FEATURES—Brochures, 4 pp. Discusses Model 2A-1. Construction features specs and dimensional drawings. James Smith & Son, Inc., 982 Southbridge St., Worcester 10, Mass.

Circle 54, inside back cover

MILL MOTOR—Bulletin PB-9000-2, 4 pp. Electrical details, design and construction of armature, armature coils and field coils are discussed. With mechanical-design data, photos and dimensional drawings. Elliott Co., Jeannette, Penna.

Circle 55, inside back cover

PRECISION INSTRUMENT BEARINGS—Booklet, 12 pp, discusses ball-bearing yield and system isoelasticity. Designed to assist users in applications. Offers comprehensive background data on radial and axial play, axial take-up and preloading, as well as isoelastic bearing and achievement of system isoelasticity. Of interest to gyro builders is a section on requirements for spin axis bearings subjected to transient or vibratory forces. The effect of temperature differentials on selection of preload arrangement is also described in detail. Barden Corp., Danbury, Conn.

Circle 56, inside back cover

Letterhead Requests Only

Manufacturers who published following literature ask that requests for copies be made on company letterheads.

PROPOSED SAE STANDARD—82 pp. Proposed Standard on Involute Splines, Serrations, and Inspection is now in preparation. Copies of the tentative draft are available for criticism and comment. Standards Dept., American Society of Mechanical Engineers, 29 West 39th St., New York 18.

ESTIMATING MACHINING COSTS

Practical manual gives you proved ways to insure reliable cost estimates of machine-tool operation. Shows how to break down a machining job into separate factors, how to accurately figure the cost of each. In addition there is essential information on cutting tools, materials handling, motion economy, and mechanical equipment. **By C. W. S. Parsons, Cal. State Polytech. College. 366 pp., 112 illus., $8.00**

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Emphasizing **properties** rather than occurrence, production, or use of materials, this book gives the engineer a sure mastery of fundamentals for dealing with today's materials problems—and those of tomorrow. Shows you to what extent important properties are present in different materials—how they can be measured—for what purpose their presence is desirable, etc. **By J. P. Frankel, Tech. Inst. of Northwest U. 225 pp., 16 illus., $6.00**

PROCESS INSTRUMENTS and CONTROLS HANDBOOK

Here are the instrumentation techniques to help you **detect, measure, record** and **control** industrial processes. From simple measuring instruments to complex mathematical techniques, you will find here the kind of help that is valuable, time-saving, and based on the best experience in the field. **Edited by Douglas M. Considine, Hughes Aircraft Co. with the aid of 71 experts in all fields of instrumentation. 1383 pp., 1137 illus., $19.50**

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Provides the engineer with the know-how for undertaking management relations and responsibilities. Chapters discuss production costs and their control; the basic financial transactions of a business enterprise—insurance, depreciation, taxes, power, labor, etc; the concepts of authority and responsibility; and the higher-level decision-making processes. **By Roger C. Heimer, Villanova Univ, 453 pp., 41 charts and tables, $6.75**

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PREVIOUS PROCEDURE

1 Drill bolt holes in "clip angles."

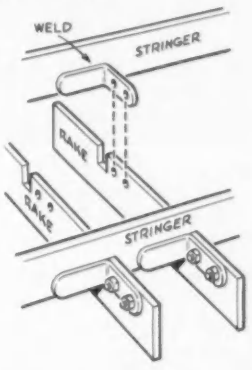
2 Weld clips to stringer.

3 Drill holes in rake blades.

4 Mill stringer slots in rake blades.

5 Bolt rakes to clip angles.

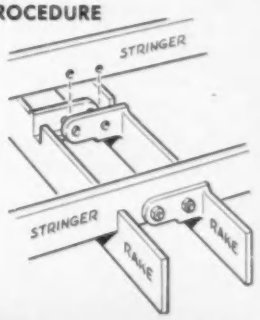
REPEAT FOR EACH BLADE

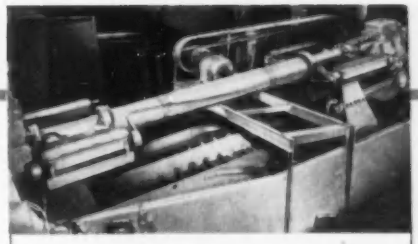


PRESENT PROCEDURE

1 Drill bolt holes in stringer.

2 Bolt one-piece castings (complete with holes, slots, and flanges) IN RIGHT- AND LEFT-HAND PAIRS, to stringers.





Type H rake classifier made by Dorr-Oliver Inc., of Stamford, Conn., separates solids in liquid-solid mixtures into two fractions according to particle size. Fine materials overflow with liquid at lower end of inclined tank; larger particles settle to tank bottom, are continuously raked up inclined slope and discharged "over top". Rake blades move in oval track due to motion of rocker head, must be precisely aligned to move settled material up to next rake without either scraping or undue clearance.

Use of Cooper Alloy close-tolerance shell casting eliminates 3 out of 5 machining operations for Dorr-Oliver rake classifier blades, showing

How to Cut Fabrication Costs with Close-Tolerance Stainless Castings

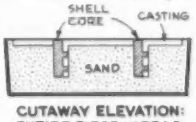
Previous method of attachment of rakes to stringers was by "clip angles" welded to stringers, drilled and bolted to simple flat blades themselves drilled and slotted as shown. Construction was expensive, and often unsatisfactory, in that heat of welding tended to put rakes out of alignment.

In redesigning, Dorr-Oliver decided to eliminate the clip angle as a separate third piece by incorporating it into the blade castings. Original conception was to cast rough slots and holes, then mill and drill them to dimensions. Cooper Alloy, after study of the piece, determined that with close-tolerance plastic shell cores, both bolt holes and stringer slots could be cast directly in the rake blade, without need of further machining. Also, that by using right- and left-hand patterns of rake flanges, *two* rake blades could be bolted to stringers with one set of bolts.

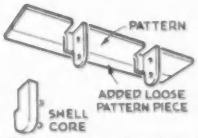
Casting requirements stringent

- Bolted face of each of the upright flanges required a smooth finish (250 A.S.A. Standard).
- 11/16" cored holes had to be smooth, accurate to ±.010", and precisely positioned for proper fitting of parts.
- Stringer slots had to be precisely positioned, accurate in dimensions to ±.025".
- Multiplicity of patterns for different widths of rake blades had to be reduced, for economy.

Casting solutions For the critical flange faces and bolt holes, shell "cake" cores, capable of holding precise dimensions down to ±.010", were prepared. They were inserted and became an integral part of the green-sand molds that formed the less critical outer blade areas.



CUTAWAY ELEVATION: ENTIRE PIECE IN DRAG.



To save cost of a complete new pattern for each rake size, all sizes of rake were designed to have the same blade thickness and flange dimensions. Patterns were then made of the narrowest-width blade in each series, loose pattern pieces being added to increase blade width of the larger rake sizes.

Results —"These rake blades", says Dorr-Oliver, "were used directly as cast, with no additional machining of any kind. Dimensions were precise, surfaces smooth, and finished alignment better than with previous 3-piece welded assembly. New procedure saves time and handling, and has reduced our manufacturing costs on this piece considerably."

Such economy possibilities are available in almost any shape, no matter how simple, or how "cut-and-dried". Cooper Alloy has specialized for 35 years in achieving such uncommon results in close-tolerance stainless steel castings, and can do the same for you.

To check on it, why not take advantage of our Foundry Engrg. Service? Just send us (without obligation) a blueprint or outline of your problem part, for cost analysis, to: Foundry Products Division, COOPER ALLOY CORPORATION, Hillside, N. J.

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Tangents...

About Itches and Such

How often have you said, "I have an itch for . . ."? That's a mental itch and one that can be scratched only by gratification, not by fingernails. It's of considerable importance, because now it appears that a mental itch that you try to scratch will keep you from noticing the physical ones.

A recent medical report explains that we all have itches all the time—physical ones—because the human body is designed to itch. But we don't notice the physical itches until we're bored. That's why so many people scratch themselves, nowadays.

Psychologists and medical men are mentioning more and more frequently that our hectic pace is the result of boredom, not of the need to work. Working hours and work loads have been dropping steadily, and physical labor is being replaced by mechanical muscle. Even the leisure occupations that once required energy do not any longer. We have power lawnmowers in summer and powered snow shovels in winter, automatic heating, automatic dishwashing and lawn sprinkling. Even the golfer and fisherman use powered transportation to and during their sports.

So now we drive cars and boats faster, rush through meals, cut down on sleep, do everything at a wilder pace—to keep from being bored stiff. Somehow, we "have no time for" the more relaxing pursuits. Reading, thinking, and just sitting are not very popular. Even the child who sits quietly is assumed to be sick—or psychologically troubled. The idea seems to be to beat every minute to bits on the whole path from cradle to grave.

For the engineer and executive, reduced working hours are somewhere between a tragedy and a joke. The tragedy is that it is the engineer who must compensate with new developments for each reduction in working hours—developments that are never given proper credit because they serve primarily to neutralize added costs. The joke is that development and management are alike in that neither is bound by a time clock. Fewer hours in the plant mean more hours outside, solving a knotty problem. Thus the gain from cutting hours is entirely for the routine worker—the machine operator, the button or pencil pusher, the clerk. He benefits, and eventually begins to think he is responsible for, the gains in capacity as they are made. Let's just take a look at working hours. In 1776, the working week was 80 hours. By 1850, it had dropped to 69.8, by 1880 it was 64, and by 1900 it was 60.2—a decline of 25% in a century and a quarter. But it has dropped again as much—and more percentagewise—in less than half that time since. In 1920, the work week was down to 49.7 hours, by 1940 it had dropped to 44 hours, and in 1955 it was 40.2. At that rate, it will be 36 hours by 1970. Informed sources bet that 1965 is more likely.

This all amplifies the problem of leisure time. Everybody considers a 4-day week as a very delightful idea, but a great percentage of the population is having trouble disposing of only two spare days a week. Many have raised their standard of living and are maintaining it by "moon-lighting"—holding two jobs. In many families, too, we have reverted to the custom of having both husband and wife work. Some of this is of course to maintain a higher living standard, but some is the result of inability to make good use of leisure time. Other wives "make" work in civic activities to occupy leisure time created by machines. More and more people cry that they have no leisure time, yet wouldn't know what to do with it if they could salvage it from present pursuits that provide no long-term profit.

The man who refuses to work with his hands on the job, works like a dog at home. The man who can not stand up at a machine, stands up and walks for a four-hour stretch pushing a little white ball ahead of him with a stick, or wading the icy streams behind a fish hook. These are all violent efforts to have what all the advertisements define as "fun." It is now supposed to be fun to smoke, to save

(Continued on page 146)

NEWS FROM FLEXONICS

BELLOWS APPLICATION ENGINEERING

One of a series of reports on more effective use of metallic bellows in new or unusual applications.

BELLOWS TYPE VACUUM VALVES

How Westinghouse uses Flexon Bellows in the vacuum system of Ignitron Rectifiers

The Ignitron Rectifier manufactured by Westinghouse Electric Corporation is an ingenious utilization of the rectifying property of the mercury vapor arc. This development has not only extended the scope of mercury arc rectifiers to the lower voltage range, but has provided new high standards of performance.

Maintenance of Vacuum Is Essential

It is essential that the Ignitron be substantially free from gases other than mercury vapor. Westinghouse provides the means of evacuating the tube with an integral vacuum system. Vacuum is maintained by a continuously operated mercury vapor vacuum pump capable of evacuating a vessel to the order of a fraction of a micron. The mercury vapor vacuum pump discharges to an interstage reservoir which in turn is exhausted by a rotary vacuum pump.

Two bellows type vacuum valves are used in the system. In both, Flexon stainless steel bellows are employed as shaft seals.

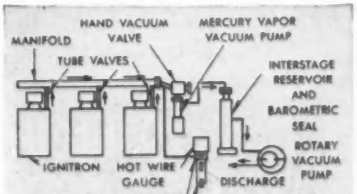

Fig. 1 Schematic view of vacuum system for Ignitron Rectifiers.

The Hand Operated Vacuum Valve

The bellows type vacuum valve is designed especially for use between the rectifier vacuum manifold and the mercury vapor vacuum pump. It consists of a machined steel bar, one end of which is made to form a vacuum gasket seat and also hold the movable mechanism of the valve. The other end of the valve body is drilled to form the valve intake. The outlet is a machined hole in the side of the valve body.

The bellows assembly consists of a stainless steel bellows welded to the bolted-on portion of the valve and also to a steel bar with flange at the lower end of the bellows. A rubber gasket is bolted in place to the flange end of the steel bar.

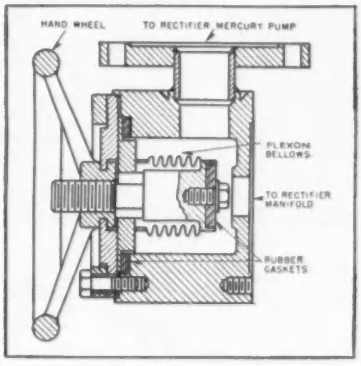

Fig. 2 Cross section view of the bellows type vacuum valve used between the rectifier and the pump.

The Three-Way Vacuum Gauge Valve

A three-way bellows type valve is employed in connections to the vacuum gauges. It is similar in design and construction to the valve used in the vacuum pump line except that it is provided with an additional port.

Valve Quality and Life Depends on Bellows

In devices such as these, the ability of the valves to hold the required vacuum level depends on the leak tightness of the bellows. The life of the valve depends on the bellows' resistance to fatigue developed in opening and closing the valves. In the face of these potential dangers, bellows quality and dependability are essential.

Fig. 3 Valve mechanism being lifted out of the valve body.

Why Flexon Bellows Are Used

Westinghouse uses Flexon Bellows Assemblies in the Ignitron Rectifiers to take advantage of Flexonics Corporation's facilities and bellows manufacturing know-how. Flexonics' application engineers are cost conscious, skilled in recommending the bellows or bellows assemblies that provide the performance required by the device at the lowest price consistent with these requirements.

Engineering Assistance

The Flexonics Application Engineering Staff will be pleased to assist you in your bellows application problems. For specific recommendations send an outline of your requirements. For your bellows reference file, write for the Flexon Bellows Design Guide.

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money, to fly, to brush your teeth, or go in hock for a new car.

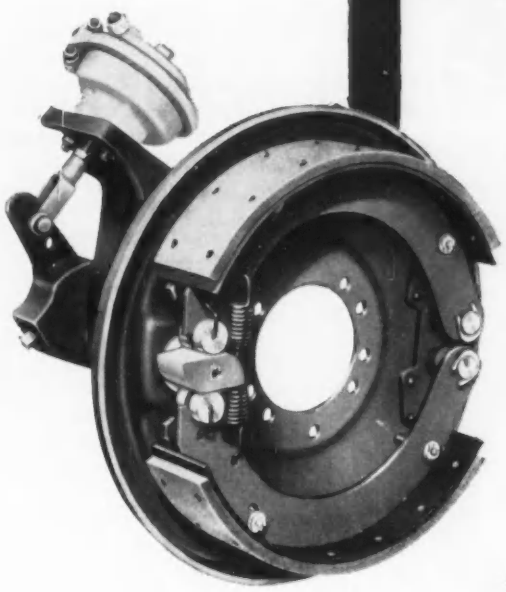
Said Clifton Fadiman in *The Saturday Review* (August 31, 1957):

"One of the marks identifying a revolutionary period is the speed with which a shocking statement changes to a boring one. It has taken us only about five years not merely to become used to, but to yawn over, the repeated announcement that—barring war, revolution, or economic bust—the age of leisure is at our doorstep. It is all so accepted: the thirty-hour work week is around the corner; the twenty-hour work week is around the next corner; automation is solving the problem of production; Father Time is sitting expectantly on our hands.

"There is a certain danger in everybody all at once hearing about something as crucial as the imminence of leisure. This danger was less dire in former days when communication was subject to normal and perhaps advantageous delays. Now there is a tendency to absorb the instantaneously received idea, mentally file it, and proceed to the next message transmitted by the tireless mass-communicators. With so many signals crowding in upon us there is no time, and soon no inclination, to arrange them in order of importance, reflect upon them, and take proper action. Eventually the alert reception of the signal suffices. We delude ourselves into thinking that because we know a thing we have done something about

(Continued on page 148)

"I'll tell you one thing, there aren't any pure scientists working for this company!"



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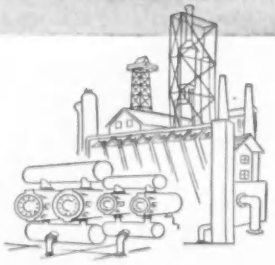
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it: our equivalent of the primitive's belief that to name is to control.

"Perhaps we might be stirred to more useful action if it were made clear that wholesale leisure is not only an opportunity but a peril. Just because the word *leisure* has traditionally pleasant connotations we may fail to realize that it presents us with a critical as well as a novel state of affairs. It is like peace. Peace is associated with calm, rest, harmony: it sounds like a passive state. But if we should ever really be pitchforked into a universal peace we would in a daze wake up to the fact that it is a dynamic state, and that the proper use of peace necessitates the calling forth on a vast scale of human energies that have hardly been stimulated, much less tapped."

A key point is that we seem to have lost the distinction between the words "leisure" and "play." The latter is of course complete relaxation, indulging in childlike games. But "leisure" in Greek is the word *scole*, which not only looks like our word "school"—but in ancient Greece *meant* "school" —and "leisure" too. Thus leisure implied some training or learning—the indulging in a pursuit that builds the mind.

This is the crux of the problem. Boredom results not only from repetitive work, but from repetitive play. Even children, recognizing this fact instinctively, change their type of play with the seasons. There are seasons for baseball, for stickball, for mumblypeg, and for marbles. And children's play is surrounded by restrictions which the adult does not have—area, time, associates.

The child, too, automatically spends a great deal of time learning, if only by observation and picture books. But the adult too frequently has no equivalent regimen. He reads daily papers, lighter magazines, watches TV. Only a limited few read books, take courses, read technical or other reports. Thus the mind stagnates, and boredom is the inevitable result.

This is because we associate anything that takes effort—mental effort —with work. Yet to the ancients, who knew work as hard physical labor, leisure was the time in which they could do what they chose. They chose to study, to talk with sages, to do the things they wanted to do. They had

(Continued on page 150)

Fastener Facts

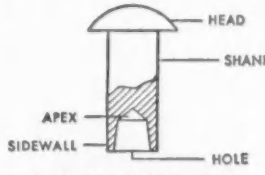
by Henry Peterson, Chief Engineer — Judson L. Thomson Mfg. Co.

DESIGN PRODUCTION & PURCHASING DATA

FASTENING WITH SEMI-TUBULAR RIVETS

WHY RIVETS?

You specify rivets when you want strong, permanent fastening at low cost. However, secure fastening is not their only function. You can also use them as fulcrums, pivots, cam followers, electrical contacts, studs, stops and in many other applications.



Typical semi-tubular rivet

WHY SEMI-TUBULAR RIVETS?

You specify semi-tubular rivets when you want to combine the high shear and compression strength of solid rivets with low-cost, high-speed fastening. The required strength is inherent in the design of Thomson Semi-Tubular Rivets.

Shallow holes in solid shanks distinguish semi-tubular rivets from other types. The hole is seldom deeper than shank diameter. Its depth is determined by clinch requirements of specific applications. A general rule is to select a rivet with length equal to the thickness of the materials *plus* 55% of the diameter of the shank. A Thomson engineer can quickly specify the correct rivet length and hole depth for any particular semi-tubular riveting application.

Semi-tubular rivet applications call for pre-drilled or punched holes in the materials to be fastened: metals, plastics, wood, ceramics and other hard materials. The size of the prepared holes is an important design consideration. When holes are too small, rivets choke. When too large, rivets buckle. To avoid either error, make sure that each hole is about 7% larger than the maximum shank diameter of the rivet. In most cases, the setting process causes shank expansion sufficient to fill the hole. Again, Thomson engineering is at your service to help you match rivet and hole sizes.

High shear strength of semi-tubular rivets is further assured by Thomson production methods. All Thomson Semi-Tubular Rivets are made from specially prepared wire by the cold heading or upsetting process. This results in fasteners with the uniform structure and *inherent strength of forgings* . . . properties not achieved by screw-machine rivet production.

Standard materials used to produce Thomson Semi-Tubular Rivets include aluminum, brass, copper, nickel-silver, low-carbon steel and stainless steel. For special electrical and electronic contacts, coin silver, fine silver, palladium and other precious metals may be specified.

Finishing to specifications is another service of interest to design engineers. Rivets can be plated with brass, cadmium, copper, nickel, tin, zinc, etc. Morever, they can be oxidized or finished in japanned colors to match the original equipment or product.

Low fastening costs result from the application of Thomson Semi-Tubular Rivets with automatic rivet-setting machines. The low cost of rivets, as compared with most other fasteners, combined with high machine speeds invariably leads to production line economies. Machines are low in initial cost and require little maintenance. Furthermore, they can be operated by unskilled labor.

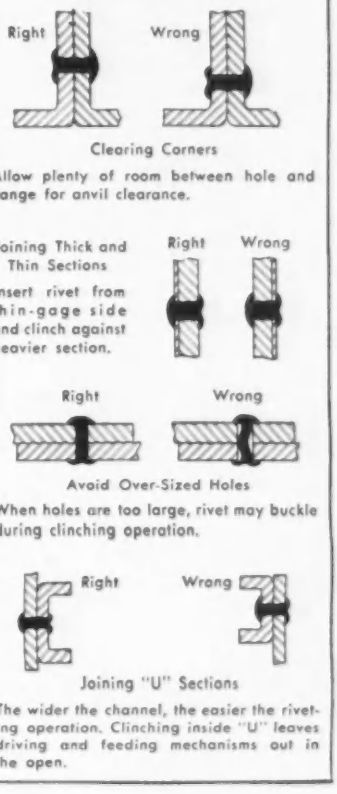
FLOOR-TYPE FOOT-OPERATED — FLOOR-TYPE MOTOR-OPERATED

HIGH PRODUCTION RIVET-SETTING MACHINES

Thomson has developed more than 200 styles of modern, high speed machines which can be adapted to innumerable fastening jobs. These machines are divided into three basic models: floor type with foot-pedal operation, floor type with motor operation, and bench type with motor operation. All permit automatic hopper feed for maximum speed, and some motor driven floor models are equipped for multiple rivet-setting.

Special work-handling devices accelerate riveting operations. Radial or turret feeds are common accessories for machines geared to high-production fastening of parts, as are all types of special loading fixtures. Thomson selects the proper machine to do your job most efficiently and custom-tools it to fit your fastening requirements.

DESIGN PRACTICES


Right
Wrong
Clearing Corners
Allow plenty of room between hole and flange for anvil clearance.
Joining Thick and Thin Sections
Right
Wrong
Insert rivet from thin-gage side and clinch against heavier section.
Right
Wrong
Avoid Over-Sized Holes
When holes are too large, rivet may buckle during clinching operation.
Right
Wrong
Joining "U" Sections
The wider the channel, the easier the riveting operation. Clinching inside "U" leaves driving and feeding mechanisms out in the open.

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We will gladly evaluate your fastening problems at little or no cost. Contact us while designs can still be modified for lowest cost fastening method. Simply send sketches, prints, or preferably samples of actual work.

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some play time, of course, but it was limited, because the man was evaluated on the basis of his leisure abilities as well as his working ones. Now we rate on the dollar sign; the bigger the dollar sign on his work, the faster the man feels he must play. So he has his senses stimulated by violent headlines, violent TV programs, high-speed driving, overexercise. And the ultimate effect is not invigorating, but stunning. He goes around with a post-playtime look exactly like that of his offspring who has too many toys and not enough thoughts.

He even begins to introduce playtime elements into his work day—coffee breaks, company parties, long lunches, annual conventions, office "buddies". Add to them "brainstorming", the "acting out" of selling problems or management jobs, the "well-heeled alumnus" attitude toward what were once amateur sports.

This gives solidity to the educator who builds Junior's "personality" rather than his mind, the radio evangelist who says religion and living should be "fun", the two-pistol military man who "plays" war like football, and the host of other immature minds that batten on our weakness for excitement. And so the cycle speeds up on itself—like the spiral of a snail shell.

Unless we can make an itching mind popular once again, unless foreign and domestic sputniks blast us loose from the queer combination of complacency and the hectic urge for "fun", only the skull-shattering core of our snail-shell spiral is ahead.—*EJT*

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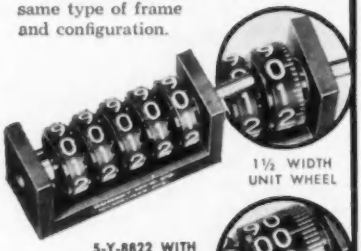

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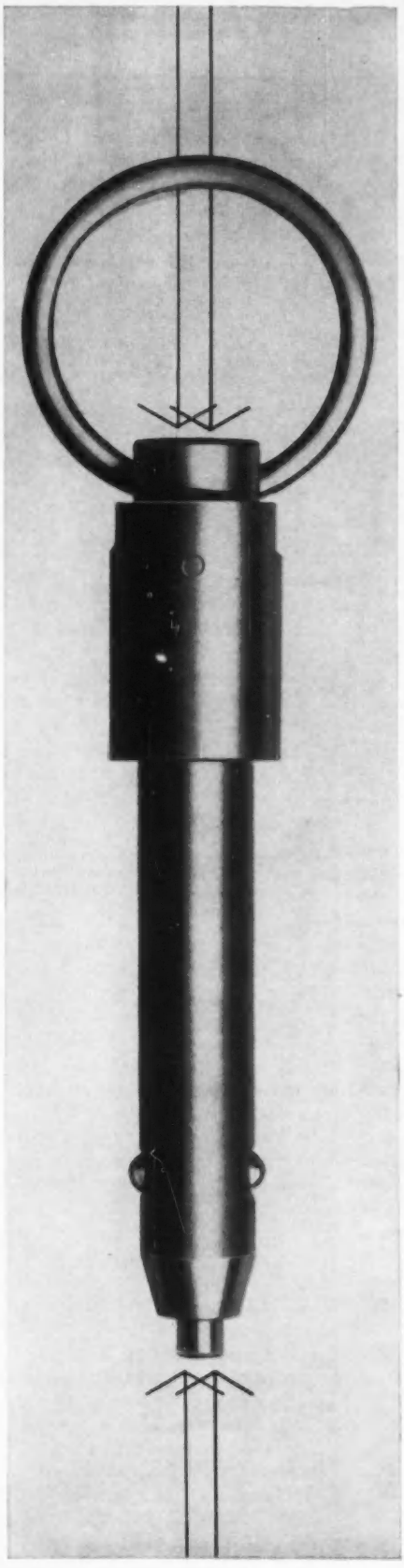

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the pin that's designed for positive release...even under "over-load" or "bound" conditions!

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Double-acting "B" Series PIP Pins have the special advantage of the exclusive PIP "drive-in"—"drive-out" feature... makes it easy to install or remove pin when misaligned holes or extra heavy loads cause "binding".

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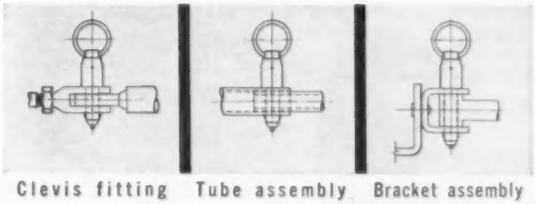

Clevis fitting Tube assembly Bracket assembly

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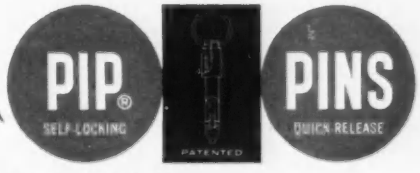

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DESIGN ABSTRACTS

Design of Noncircular Gears

Quick results are obtained from a method of designing gears to a particular displacement function. In the design of machinery or instruments it is sometimes required to vary velocity ratio or mechanical advantage between two shafts, and it is proposed to use noncircular gearing for this purpose. The basic principles, however, are not well known and a thorough investigation was carried out.

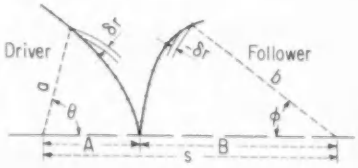
If practical, following two principles should be observed: At least one of the gears be a recognized form, e.g. circle (eccentric in these cases), ellipse, spiral; and, both gears be identical.

In applying these principles, it was found that practical problems could be classified in three groups: Design the follower to suit the driver; design a pair of gears to a particular velocity ratio; design a pair of gears for a particular displacement function.

Two of the more important special cases of noncircular gears are:

Eccentric gears: The diagram shows an eccentric gear in mesh with an approximately quadrantial rack. This was for the steering gear of a ship to give greater mechanical advantage as the rudder moved from neutral position and experienced greater water pressure. A standard circular gear with an eccentric boss is used and the rack designed to suit. Theoretically if the "rack" were a rounded square, continuous rotation would be obtained.

Elliptical gears: These have the advantage that they can be made identical, have recognized forms, give continuous rotation and have a symmetrical velocity-ratio curve. A modern application is in the actuation of aircraft control surfaces where, conversely to those of a ship, the function is to give a greater velocity ratio during maneuvering. In this case notation is not continuous but full advantage is taken of the peripheries. Elliptical gears have also been used in machine tools to give a quick return motion.



Mating Gear . . . development-pitch lines.

Abstracted from "Design of Noncircular Gears," by W. H. Sheppard, B.Sc. (Eng.) Mechanical World and Engineering Record, July 1957, 31 King St. W., Manchester 3, England.

How to Barrel-finish Eggs

Author admits there was no practical reason for barrel finishing blue-lacquered raw eggs in an abrasive mixture. However, it is pointed out that his successful experiment proved that the process has come a long way since such equipment was used solely to break fins from castings.

Today, control of six processing variables (size of media, barrel speed, mass height, water level, ratio of work to media, selection and use of compound) makes it possible to produce a variety of finishes on a wide range of products. Some of the elements of part designs that influence barrel finishing are size, shape, material, holes, projections, slots, and finish desired.

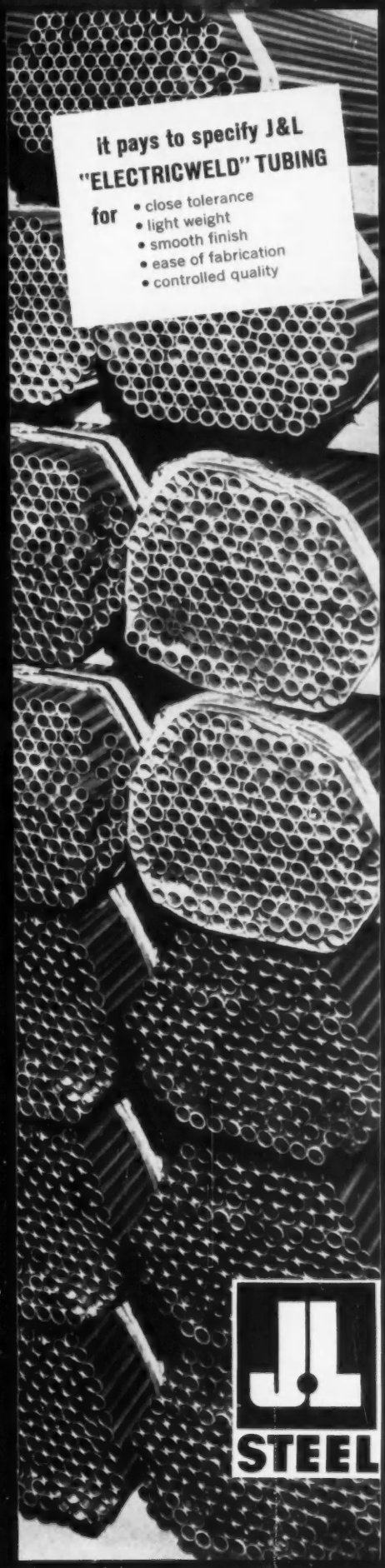
Abstracted from "How to Barrel-finish Eggs," by William Biebel, Esbec Barrell Finishing Corp., Plating, Jan. 1958, 445 Broad St., Newark 2, N. J.

Characteristics of Silicone Bearing Lubricants

Research and development in the electric motor field have created the need for antifriction-bearing lubricant with long life and operability over an ever-broadening temperature range. Silicone greases meet requirements of many such applications. Development of new thickeners has extended the high-temperature limits of these products. Lubricant requirements of bearings for electric motors in future aircraft will not be fully satisfied with available materials. Efforts to produce improved silicone greases to meet these needs are progressing.

Most promising fluids available for formulating lubricants to meet such requirements are the silicones. If the most suitable of these products were combined with the most stable thick-

(Continued on page 155)



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"Electricweld" tubing may be the answer to *your* design and manufacturing problems. Your nearby J&L representative can recommend the exact shape, size, gage and grade of tubing for your products. He frequently can reduce your costs, improve your product. Call him today, or write for information based on your specific requirements to Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

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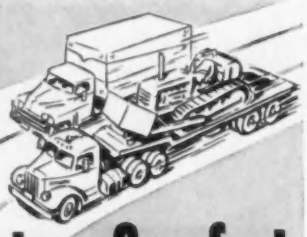

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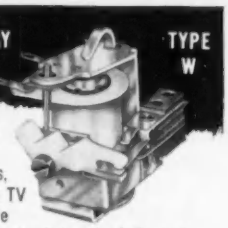

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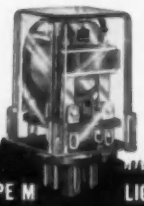

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ener available, a grease with the following characteristics might result:

1. Operating temperature range of −85 to 450F.

2. Bearing life of 1000 hr in 204 bearings at 10,000 rpm using C.R.C. test methods at 450F.

Abstracted from "Characteristics of Silicone Bearing Lubricants," by W. H. Ragborg, Dow Corning Corp. Presented at SAE annual meeting, Detroit, Jan. 1958. SAE, 485 Lexington Ave., New York 17.

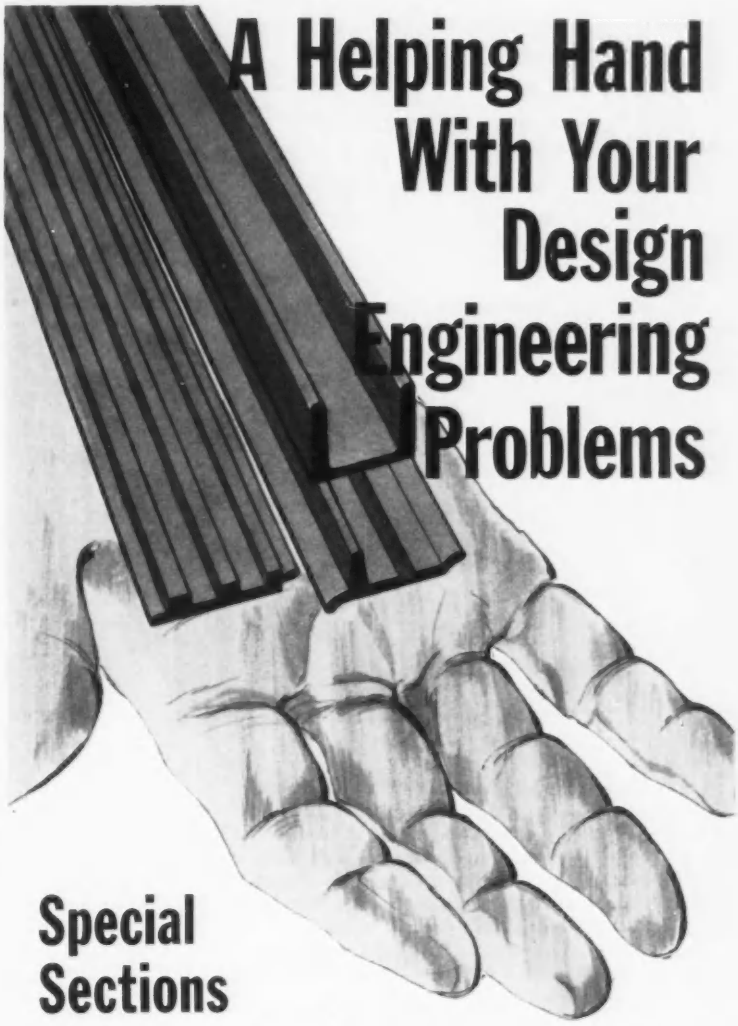
Flange Loadings

In a gasketed joint, seals are created chiefly by compression loads. Obviously there are a number of other factors involved in the over-all sealing problem, and many are not too well understood today. However, none seem to be more crucial than getting proper amount of initial flange pressure on gasket. Recent research has shown, rather strongly, that gaskets require certain min loads above which sealing conditions appear to be the general rule.

Surprisingly little information on recommended loading conditions for gaskets and techniques for finding flange loads in existing flange designs is available. Consequently, this paper deals with, (1) a procedure for estimating gasket loads in current flange designs, (2) the min sealing loads for gaskets representative of those used in the field of low internal pressures and (3) the combining of these two things in such a way that they can be used for purposes of flange design or gasket selection.

Abstracted from "Flange Loadings in Flange Design and Gasket Selection," by E. M. Smoley, Armstrong Cork Co. Presented at SAE Annual Meeting, Detroit, Jan., 1958. SAE, 485 Lexington Ave., New York 17.

"I'm afraid Burton has been perched on that stool too many years."



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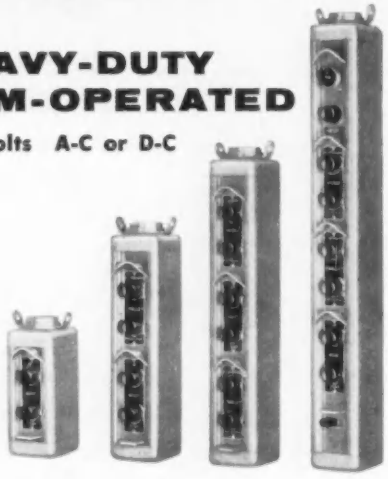

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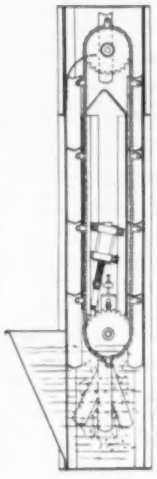

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Available from Kodak industrial dealers, or Eastman Kodak Co., Rochester 4, N. Y. Kodak Publication No. P-2. Paperbound, 5⅜x8½, $0.75.

This is a second edition revised to include the new techniques of ultraviolet and infrared photomicrography, cinephotomicrography, and phase and electron microscopy. The book also includes descriptions of equipment and conventional techniques for making photomicrographs. It is a good introduction to the subject for amateur photographers wishing to study and record the microscopic world. Scientists and engineers already familiar with the subject will find helpful data covering available Kodak materials, exposure calculation and processing advice.

Permanent-magnet Generators

Available from Office of Technical Services, US Dept. of Commerce, Washington 25, D. C. PB 121862, 10x7½, 16 pp. $0.50.

Permanent-magnet generators are superior to the conventional field-wound type, for some applications at least, the Naval Research Laboratory believes. This report tells why, diagrams magnetic circuits, and gives literature references.

Layout of Workplaces

JEROME H. ELY, ROBERT M. THOMSON, and JESSE ORLANSY. *Available from Office of Technical Services, US Dept. of Commerce, Washington 25, D. C. 10x7½, 104 pp. $3.*

A critical factor affecting the operator's performance in any man-machine system is the layout of his workplace. This report provides a compilation of human-engineering recommendations concerning various aspects of workplace layout. Whenever these recommendations are the direct outgrowth of research in this field, the

(Continued on page 159)

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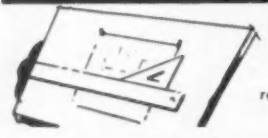

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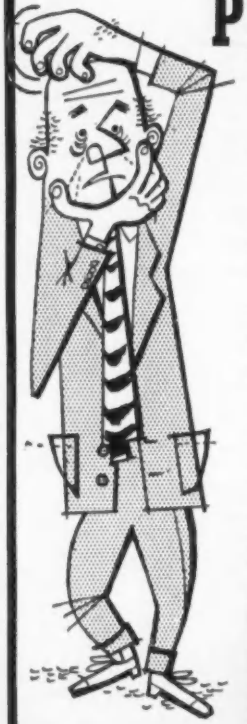

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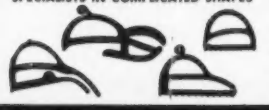

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appropriate research studies are cited. When no research has been done on a specific problem, the authors draw upon their own experiences for suggestion. All recommendations have been reviewed by a number of experts in the field. The report is divided into four main parts: general considerations, workplace dimensions, location of controls and displays, direction-of-movement relationships.

Elements of Physics

A. W. Smith and J. N. Cooper. *Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36.* 8¼x5¼, 671 *pp.* $7.50.

This is the sixth edition of a textbook for the college general-physics course, suitable for arts-college students interested in physical science for educational reasons, and for the engineering course in schools where calculus is not a prerequisite for physics. It covers the conventional areas of mechanics, sound, heat, light, electricity, electronics, atomic physics, and nuclear physics.

Much of the detail of the previous edition has been eliminated to make room for recent developments in physics. Emphasis continues to be on the practical application of physics to everyday living, and there are many examples related to engineering, biology, medicine, chemistry and agriculture. The section on electricity and magnetism is completely rewritten and reorganized in this edition. There are approximately 200 new figures and double the number of problems, with answers to odd-numbered problems.

Radiography in Industry — Second Edition

Published by Eastman Kodak Co., X-ray Div., Rochester 4, N. Y. 10½x7½, 136 *pp.* $5.

The revised edition contains information on sensitometric characteristics of Kodak films, new data on radioactive isotopes and their application, a guide for selection of films for both X-ray and gamma-ray radiography. There is also new material on image amplification, geometric enlargement and radiation monitoring.

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(Continued on page 161)

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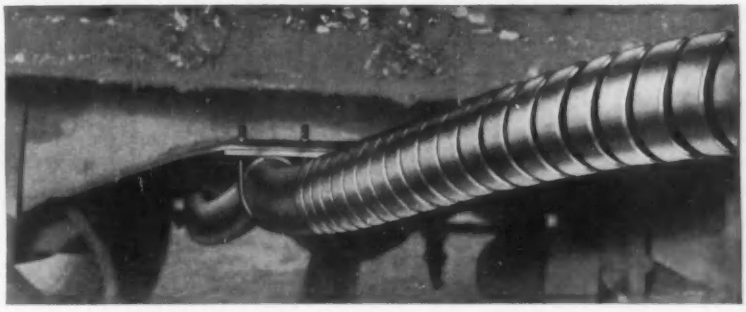
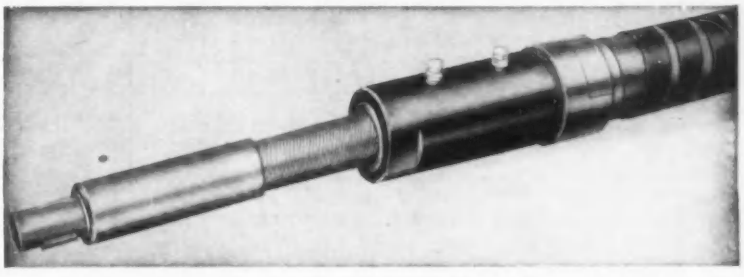


1¼" flexible shaft under tractor-trailer transmitting 10 HP.



1¼" core assembly pulled out of casing. Note steel-backed bronze sleeve bearing.

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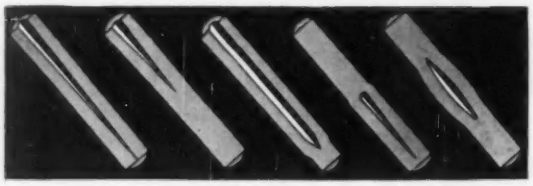

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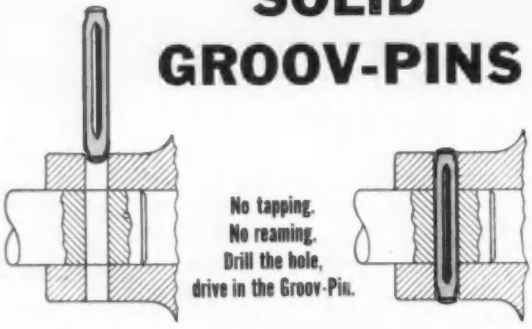

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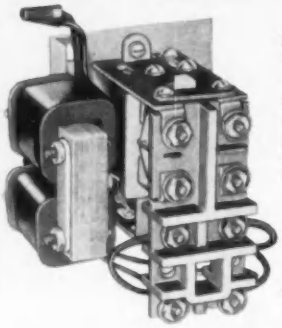

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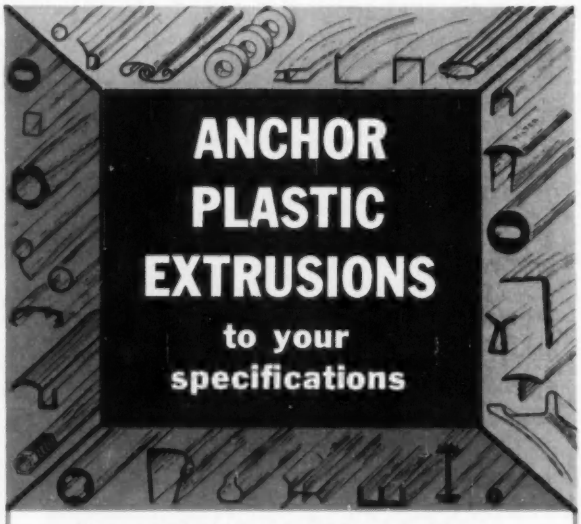

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Information Retrieval — Vol. I and II

JESSE H. SHERA, *General Editor. Published by Interscience Publishers, Inc., 250 Fifth Ave., New York 1. 6½x9¼, vol. I, 217 pp., $4.75; vol. II, 639 pp., $12.*

Classification and retrieval of scientific documents have received so much attention in recent years that the many papers and monographs on the subject may themselves be overlooked in the current snowstorm of scientific information. This series is intended to preserve such papers and to encourage further contributions to library theory and practice.

Volume I contains proceedings of two symposia of the Div. of Chemical Literature held in 1955 and 1956. The symposia were entitled "Results of the Practical Application of Punched Cards to Indexing" and "New Tools for the Resurrection of Knowledge." The papers have been printed in a logical sequence from basic principles, to functions, applica-

(Continued on page 163)

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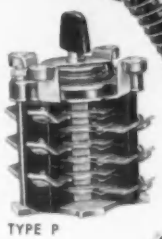
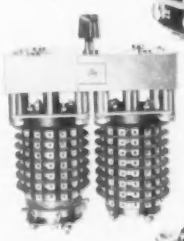


TYPE JR

TYPE P

gear-operated TYPE JR

TYPE A/AF



geared pair TYPE HT

TYPE JS-JD

TYPE HT

ESCO standard components are assembled to meet your requirements.

A deviation from one of our standard switch assemblies will give you a *special switch* at a standard-switch cost.

Over 90% of our production is *special* in one way or another.

These standard switches can be modified to fit your application:

- *Type A* — up to 8 positions, 7 sections maximum, detent mechanism, rating 5 amp. 125 volts a-c/30 volts d-c.
- *Type AF* — up to 8 positions, 6 sections maximum, detent action, rating with resistive load 5 amp. at 28 volts d-c or 115 volts 400 cps, per MIL-S-6807.
- *Type P* — Multi-section, up to 4 positions, snap-action, rating 10 amp. 125 volts a-c, 5 amp. 125 volts d-c, 30, 60, 100, 200 amp. 500 volts a-c, or 250 volts d-c. Can be assembled to meet Specification MIL-S-15291.
- *Type JR* — up to 8 positions, 30 sections maximum, detent action, rating 10 amp. 125 volts a-c, 5 amp. 125 volts d-c.
- *Type JD-JS* — up to 8 positions, 5 sections maximum, detent action or snap action, rating 30 amp. 230 volts a-c.
- *Type HT* — up to 16 positions, 10 sections maximum, detent action, rating 5 amp. 125 volts a-c.
- *Geared-Pair Type HT* — up to 16 positions, 20 sections maximum, detent action, rating 5 amp. 125 volts a-c. A single knob controls two Type HT switches assembled with a gear mechanism.
- *Navy Switches* — to MIL-S-15291 and Bureau of Ships drawings 9000-S6202-73075, 73826, 73827, 73295, 74422, and others.

Write for data sheets on individual switches or complete new catalog on ESCO rotary multipole switches. Send us your requirements and we'll give you full specifications on the ESCO switch that meets *your* need.

ESCO of WEYMOUTH
ELECTRO SWITCH CORPORATION
Weymouth 88, Massachusetts

CENTRIC

CENTRIFUGAL CLUTCHES AND CLUTCH COUPLINGS

For NEW power drive designs

Any type power drive can be improved with Centric Centrifugal Clutches or Clutch Couplings. Here's why!

Simplified design with a minimum of working parts for a long trouble-free life.

Controlled fabrication to meet our high standards of accuracy and close tolerances.

Assured performance for smooth cushion starts, controlled acceleration, overload protection.

Adaptability for any type drive. There's a model for every drive need whether direct motor drives, engine or dual drives, indirect drives.

What is your drive problem? May we help solve it?

If you require instantaneous positive disconnect from your driver in event of an overload condition, investigate the Trig-O-Matic Overload Release Clutch, Bulletin #304.

CENTRIC *Clutch Company*

P. O. BOX 175 • U. S. ROUTE 9 AT MAIN STREET • WOODBRIDGE, N. J.

Direct-Air VALVES for Easy AUTOMATION

COMPLETE VALVE CATALOG Ready!

MEADMATIC

4-way pilot-operated air valve for direct or remote control—no delicate electrical hookup needed.

A light momentary touch on limit switch actuates main valve piston—response is instantaneous! Catalog free.

Write today!

MEAD SPECIALTIES COMPANY

4114 N. Knox Ave., Dept. PE-28, Chicago 41, Ill.

PATHFINDER IN AIR POWER AUTOMATION

TRU-SEAL STOPS PIPE THREAD LEAKS

PAT. PENDING

Satisfaction Guaranteed Or Money Back TRIAL OFFER

Tru-Seal Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope.

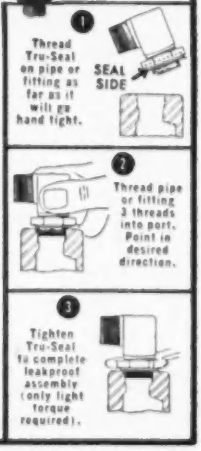
$10.00 Trial Offer No. 1: eight ⅛", ten ¼", eight ⅜", ten ½" NPT pipe thread Tru-Seal Fittings.

$10.00 Trial Offer No. 2: eight ½", ten ¾", four 1" NPT pipe thread Tru-Seal Fittings.

Send order to

TRU-SEAL DIVISION
FLICK REEDY CORPORATION
2002-04 N. HAWTHORNE
MELROSE PARK, ILL.

"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.


1
Thread Tru-Seal on pipe or fitting as far as it will go hand tight.
SEAL SIDE
2
Thread pipe or fitting 3 threads into port. Point in desired direction.
3
Tighten Tru-Seal to complete leakproof assembly (only light torque required).

tions and, finally, research in progress in the indexing field.

Vol. II records papers presented during the Symposium on Systems for Information Retrieval held in April 1957. Automatic and semi-automatic methods were emphasized, though not to the neglect of traditional cataloging, indexing and classification systems.

A Bibliography of Fluid Power

Edited by Education Committee of National Fluid Power Assn. Published by National Fluid Power Assn., 1618 Orrington Ave., Evanston, Ill. Paper Binder, 8½x11, 120 pp. $2.

A cross-section of best books on fluid power published in last 20 years or so. Information includes author, publisher, date, price, pages, illustrations, table of contents, and a one-paragraph summary of each book. Indexed by field (power, hydraulics or pneumatic) and sub-indexed by scope (application, theory, control, tables, general). Avoids-civil engineering hydraulics and company product bulletins.

Marketing Research Agencies

Dr. Ernest S. Bradford, Published by Bradford's Directory of Marketing Research Agencies, 50 Argyle Ave., New Rochelle, N. Y. 7½x4½, 152 pp. $7.50.

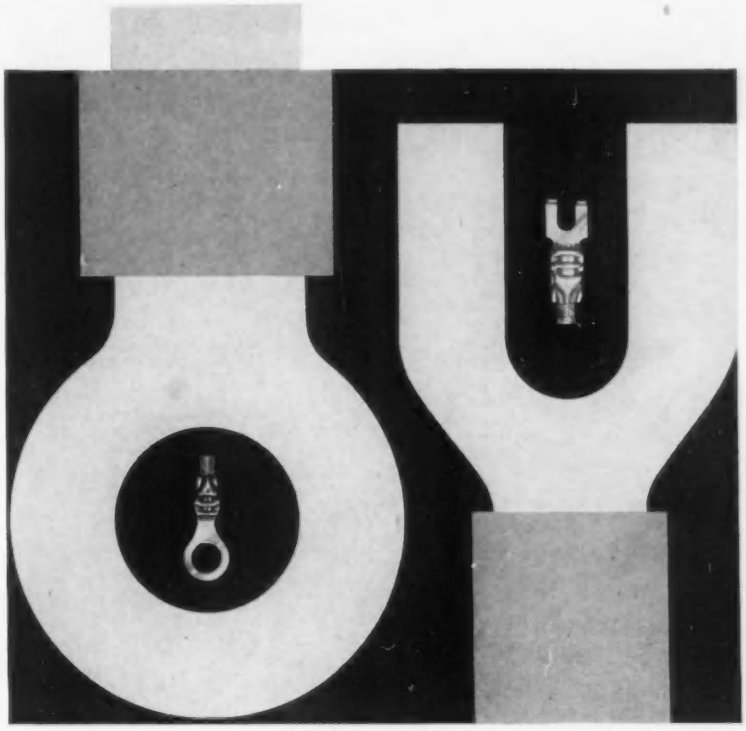
Contains the name and location of 250 or more marketing research agencies and a description of the kinds of work they are prepared to undertake. Also included is the type of personnel staffing the agencies covered. These research services are used to determine whether a product can be sold more widely; to discover new products; to check on advertising effectiveness; to find ways to improve products.

Demand for Engineers—1957

Published by Engineering Manpower Commission of Engineers' Joint Council, 29 W. 39th St., New York 18. 8½x11, 17 pp. $1.

Demand for engineers still exceeds supply, according to this report, but not by so great a margin as previously.

(Continued on page 165)



For perfect insulated termination . . .

faster . . . specify the AMP®

PRE-INSULATED DIAMOND GRIP terminal

If you need terminals with bonded insulation—if you need corrosion resistance and wire-supporting vibration resistance—you have it instantly in one closure of A-MP's matched crimping tool. Only one lightning-quick step for crimp-sure optimum strength and conductivity. A-MP Pre-Insulated Diamond Grip Terminals exceed the most rigid military and commercial specifications.

A-MP's precision-engineered terminals are matched to precision-engineered tools that make an exact crimp every time, never too little, never too much. Perfect terminations—whether you need one or a million. No great operating skill necessary. A-MP's match-mated tooling does all the work and at lower installed cost than other methods of wire termination. Wire range is from No. 26 to No. 10.

To solve your wire-end problems, we maintain an international engineering service.

For the full story on the A-MP Pre-Insulated Diamond Grip line, send for our catalog.

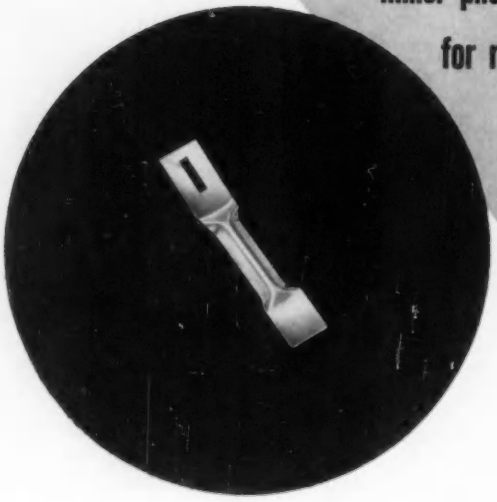
AMP INCORPORATED

General Offices: Harrisburg, Pennsylvania

A-MP products and engineering assistance are available through wholly-owned subsidiaries in: Canada • England • France • Holland • Japan

750,000 "ON AND OFFS"

Leading appliance maker chooses miller phosphor bronze for range switch part!



Miller Phosphor Bronze is consistently chosen for the tough jobs—in this instance a switch part that must withstand an estimated 750,000 "on and offs" without fatigue or fracture.

Miller *specializes* in the tailor-made production of phosphor bronze alloys—in strip, coiled and flat lengths—best fitted to your needs. At Miller, Phosphor Bronze is the main line, *not* a sideline.

THE MILLER COMPANY • MERIDEN, CONN.
ROLLING MILL DIVISION
America's Quality Phosphor Bronze

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learn the facts of **FELT**

See how **felt** fits in with your products!

Let us show you how to save money and increase efficiency with the proper use of felt.

FREE Samples and Applications of Industrial Felt.

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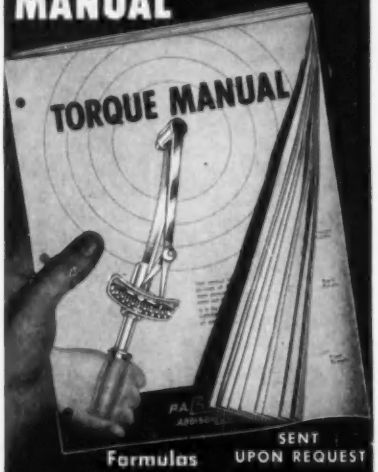
"TORQUE WRENCH" MANUAL



SENT UPON REQUEST

Formulas
Applications
Engineering Data
Screw Torque Data
Adapter Problems
General Principles

P.A. STURTEVANT CO.
ADDISON QUALITY ILLINOIS

Manufacturers of over 85% of the torque wrenches used in industry

Principal contributors to the sliding demand have been aircraft manufacturers and instrument makers who met recruiting goals this year. But reductions here have been partially offset by rising requirements of governmental agencies.

Data distilled from replies of 407 industrial organizations and 64 governmental agencies reveal that although no relief was in sight in 1956, several unforeseen factors contributed to the ebb of the sellers market. The 1957 graduating class was 20% larger than the 1956 class and reduced military demands released a greater proportion of it for immediate employment. Productivity of engineering manpower has improved. Cutbacks and cancellations in defense spending have also had their effect.

"It is evident, in looking ahead, that two alternatives exist," says the report. First, if demand-supply relations remain in near-balance, "Increasing emphasis will be placed on quality and probably many less productive and potentially weak personnel will find it increasingly difficult to maintain engineering positions." The second alternative revolves around a possible increase in emphasis on national defense, in which case continued shortages will exist for the next few years.

Although more technicians (non-graduate engineers, for purposes of this report) work in what used to be engineering capacities, demand for technicians remains roughly constant. Like engineers, technicians are less in demand in industry, more in government agencies.

Salaries for inexperienced engineers are tabulated and related to type of industry. The report reflects employment conditions as of June-Sept. 1957 and contrasts these figures with similar data for previous years.

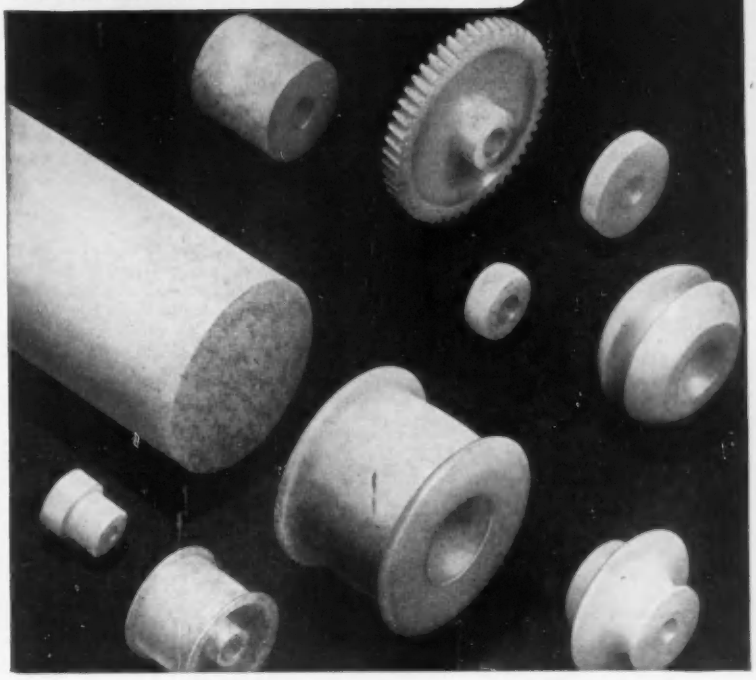
Introduction to Statistical Reasoning

PHILIP J. MCCARTHY, *Professor of Statistics, New York State School of Industrial and Labor Relations, Cornell University, published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York.* 6½x9, 402 pp. $5.75.

Quantitative data derived from either counting or measurement play

(Continued on page 167)

POLYPENCO® NYLON SHAPES



Practical, low-cost solution to nylon parts design: POLYPENCO Nylon Rod

ADAPTABLE Polypenco Nylon rod continues to be the choice of designers who require highest quality nylon *plus* rapid, low-cost production. From the complete range of sizes of Polypenco Nylon rod, it's a quick and economical step to fabricate close tolerance parts and components on standard metalworking tools. Bearings, rollers, thick gears and other parts machined from Polypenco rod have these outstanding properties:

- **Wear resistance**
- **Resilience**
- **Excellent strength to weight ratio**
- **Low coefficient of friction**
- **Noise dampening**
- **Non-galling and non-abrasive to other materials**
- **Chemical resistance**
- **Good electrical insulating properties**

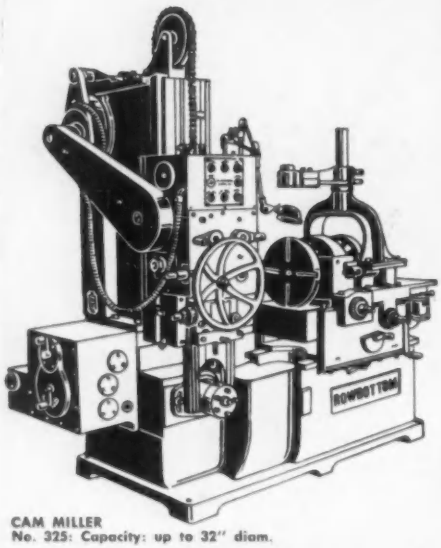
Polypenco Nylon stock shapes are also available in tubular bar, strip, tubing and plate and can be shipped immediately from warehouses located throughout the country. For fabrication of parts, The Polymer Corporation of Pa. maintains a special fabricating service. Write for data on products or services.

THE POLYMER CORPORATION OF PENNA.
Reading, Penna.
Export: Polypenco, Inc., Reading, Penna., U.S.A.

POLYPENCO

POLYPENCO Nylon, POLYPENCO Teflon-† NYLAFLOW® and NYLATRON® GS †DU PONT TRADEMARK

Rowbottom for Cams



CAM MILLER
No. 325: Capacity: up to 32" diam.

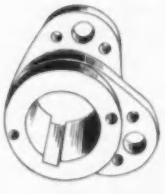
Be sure your "OE" is "OK"

Original Equipment, (OE), such as *cams*, must be absolutely correct in form and dimension to assure exactness in transmitting the mechanical motions for which they are applied. A great responsibility rests on the make of the cams. Specifications must be met *exactly* and to the smallest detail from original design to finished product.

Responsibility is what has built Rowbottom reputation from Coast to Coast . . . a reputation that was established away back in 1906 when George Rowbottom designed and built the first Cam Miller. Over the years, this reputation has grown through production of countless thousands of cams of all types . . . box, barrel, side, indexing . . . and now extended through cams hardened and ground exactly to rigid specifications for shape and bore.

Rowbottom is well equipped to assume this responsibilty for cam production either through furnishing Cam Millers and Cam Grinders or in acting as your "Cam Production Department", whichever is most advantageous for you. "Rowbottom" and "Cams" are synonomous.

Send for illustrated literature showing typical Rowbottom-produced cams and machines for making them. Outline your requirements . . . ask Rowbottom for recommendations.

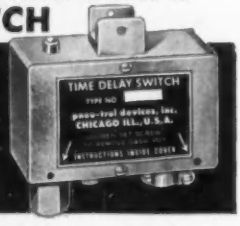


Typical cams produced on Rowbottom machines.

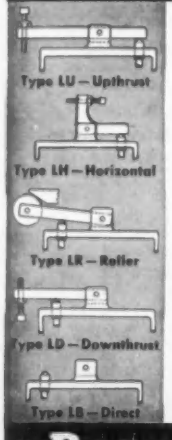
The ROWBOTTOM MACHINE COMPANY
Dept. P.E.
WATERBURY CONN.

Pneu-Trol TIME DELAY CONTROL SWITCH

. . . Gives Cylinder Applications Greater Efficiency Accuracy . . . Wider Use!

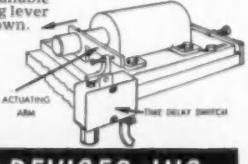


For any type actuation Left or Right Hand. (Left Hand shown)



- **Holds Cylinder dwell accurately to fraction of second.**
- **Automatically re-sets.**
- **Simple, Compact, Rugged.**

You can hold any motion or operation controlled or actuated by air or hydraulic cylinders at a positive stop on either end of the stroke for ¼ to 60 seconds in 20 to 1 ratios with Pneu-Trol Time Delay Control Switches. Simple in design with positive hydraulic timing action . . . compact and easily mounted on the machine or fixture, Pneu-Trol Switches are providing millions of trouble-free actuations in solenoid-operated cylinder applications of every type. Positive, controlled time dwell permits wider use of air or hydraulic power in automatic operations, increases accuracy of work by insuring split-second accuracy of the dwell. Available with 5 actuating lever linkages as shown.



Switch mounted to provide dwell at end of power stroke of single action, spring return cylinder.

***Pneu-Trol* DEVICES, INC.**
1440 N. KEATING AVENUE • CHICAGO 51, ILL.

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the world's finest

TRACING CLOTH

In drafting rooms throughout the world Imperial quality is the standard by which fine tracing cloths are judged. This has been true for decades, and Imperial remains the finest tracing cloth because its makers have continued to improve its quality and value.

an extremely important role in all types of human activity. From unemployment surveys to harvest forecasts, collection, analysis, interpretation, and presentation of quantitative data is vital. Moreover, decisions based on data are often, themselves, used as quantitative data for decisions on a higher level—to stimulate further research in a particular direction, or to guide a government or company in developing a program of action.

Statistics is the scientific method that attempts to provide the approach and tools for dealing with these problems.

Prof. McCarthy's book presents a careful introduction to statistical reasoning. The elements of this reasoning are presented as rigorously as possible, assuming little mathematical training. Illustrative material has been drawn primarily from investigations regarded as important and fundamental in the social sciences.

Engineered Work Measurement

DELMAR W. KARGER and FRANKLIN H. BAYHA. *Published by Industrial Press, 93 Worth St., New York 13.* 9x6, 630 *pp.* $12.

This text may prove of genuine reference value to design engineers engaged in developing products to be operated by humans. The recognized systems of work measurement and job methods analysis are surveyed. History, fundamentals, applications, standards, and accessory equipment are described and illustrated.

"If I can't find that particular blueprint, Mr. Baxton, what's your second choice?"

how to
LEAKPROOF A BOAT...

...or any product made of aluminum, steel, glass or plastics

Holes are drilled in aluminum sections, No. 590.5 applied to faying surfaces, backing easily removed, then sections riveted together. (Photo courtesy Orlando Boat Co., Orlando, Florida.)

...with PRESSTITE
oil, gasoline, water resistant sealers

On water, on land or in the air, Presstite-Keystone's No. 590.5 Seam Sealing Tape forms a permanently watertight and leakproof seal that will not dry out or crack, retains its plastic characteristics to —65°F., and is resistant to gasoline or oil. Nor will it craze plastics. It's easy to use, too . . . no mess or clean-up.

Extruded in convenient roll form, No. 590.5 is always of uniform thickness. Available from .020″ to .0625″ thick and widths from ½″ to 3″.

No. 590.5 is an aircraft-type sealer and complies with Military Specification Mil-S-7126a.

WANT A SAMPLE? Write us today on your company letterhead

PRESSTITE SEALING COMPOUNDS
PRESSTITE-KEYSTONE ENGINEERING PRODUCTS COMPANY
K A P

A Division of AMERICAN-MARIETTA COMPANY
3750 CHOUTEAU AVENUE, ST. LOUIS 10, MISSOURI

WHICH { MEYERCORD NAMEPLATE DECAL Does Your Product Require?

for abrasion resistance

for weather resistance

for smooth metals

for special surfaces

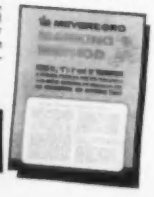
MEYERCORD Types "C", "G", "J" or "H"

Nameplate Decals designed for special problems of heat, abrasion, weathering and new finishes . . .

Heat . . . abrasion . . . weather and many of the new surfaces are deadly enemies of most types of product markings. But not to the new improved Meyercord Markings—types C, G, J and H (heat resistant). Depending upon the surface and the conditions of use, one of these new-type Meyercord Markings will, by actual test, almost certainly solve the problem. For exact recommendations designed to meet your special requirements, drop us a note outlining the problem, along with an actual sample of the surface. This service is offered without obligation of any kind.

FREE—Meyercord Marking Method

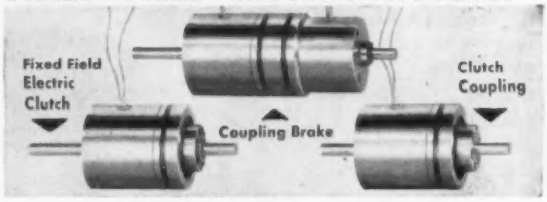
We've recently published new data about Meyercord Types C, G, J, and H (heat resistant) nameplate markings. For your free copy, please write on company letterhead.



THE MEYERCORD CO.
World's Largest Decalcomania Manufacturers
Dept. R-316, 5323 West Lake Street, Chicago 44, Ill.

Introducing . . .

Simplatrol
FIXED FIELD Electric Clutches



In Miniature and Small Sizes

Super compact for use in instruments or assemblies where space is at a premium and performance requirements are high.
Three styles of Simplatrol Fixed Field Clutches ranging from 7/8" to 3 1/8" diameter. Torque output ranges from 10 oz. inches to 100 lb. inches.

Simplatrol Diaphragm Makes The Difference!

The only functional moving part in actuation of Simplatrol Fixed Field Clutches.
When current is applied to magnet, the diaphragm yields as the armature is attracted to the rotor body. Engagement is extremely rapid, smooth and silent.
The Simplatrol principle has been proved by years of use and features a minimum of parts to maintain or replace.
Ask for literature and recommendations on Simplatrol Fixed Field Miniature and Small Electric Clutches and Brakes.

Simplatrol products corp.
24-7 SALISBURY ST., WORCESTER, MASS.
Representation in Key Industrial Areas

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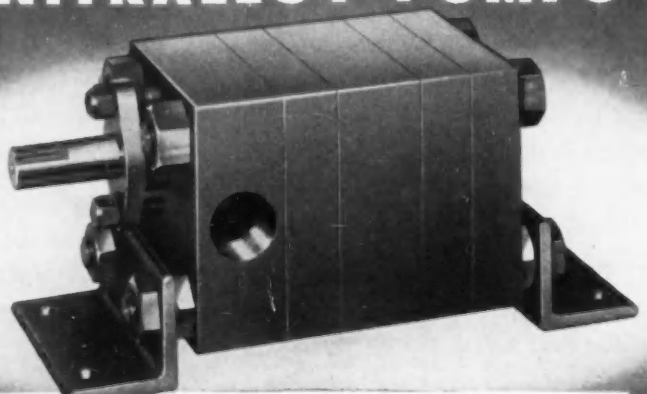
NORTHERN NITRALLOY PUMPS



Unique block construction permits selection from a wide choice of metals for virtually any pumping need. Proven in thousands of installations . . . backed by 50 years of engineering and production experience. Unexcelled for precision manufacture, accurate assembly and dependable, long-life operation. Pressures to 2,000 PSI. Capacities from ¼ to 146 GPM. *Write for free catalog and engineering data.*

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"I can find you almost anything in . . .

Product Engineering's

big, thumb-indexed

DESIGN DIGEST ISSUE!"

PRESS PREVIEWS

New Electronic Firm

Formation of Watkins-Johnson Co. to research, develop and manufacture electron devices has been announced. President is Dr. Dean A. Watkins, professor of electrical engineering at Stanford U. and director of the Electron Tube Laboratory of Stanford's Electronics Laboratories. Dr. Watkins will retain his present connections with Stanford. Dr. Watkins indicated an employment of between 50 and 75 persons by the end of 1958.

Tapes to Control Tools

A cooperative program to provide magnetic tapes for numerically controlled machine tools in the aircraft industry throughout the western US was announced at the installation of a $224,000 numerical-director unit at the Convair Div. of General Dynamics Corp.

The new US Air Force-sponsored unit is the only numerical director on the West Coast. It is an electronic device that transcribes onto magnetic tape coded instructions for numerical milling of machined aircraft and missile parts. The director can apply up

(Continued on page 171)

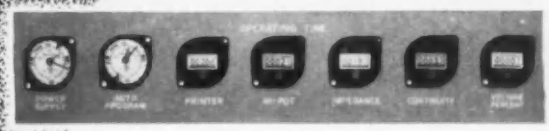
"I think it's best to work up a slogan, then design a product to fit it."

SPACE IS Valuable

... So Use the A. W. HAYDON company's

SUB-MINIATURE HERMETIC ELAPSED TIME INDICATORS.

You, too, can afford the space to keep track of time! From now on, these really small (1¼") Elapsed Time Indicators will keep company with the best of Electronic Miracles.



The illustration shows how the operating time of various sections of an electronic console can be monitored.

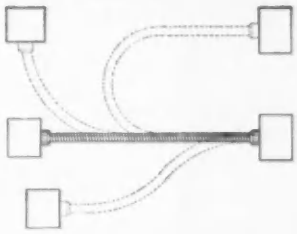
The dial type units read up to 2,500 hours in one hour increments, while the digital type units read up to 9999.9 hours in one-tenth hour increments. Designed for military applications, these 4½ ounce units can save valuable panel space in industrial and electronic applications.

The 400 cycle models now in production are described in Bulletin AWH ET 602.

The A. W. HAYDON COMPANY
221 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electro-Mechanical Timing Devices

(*Advertisement*)

FLEXIBLE SHAFTING OFFERS NEW FREEDOM OF DESIGN



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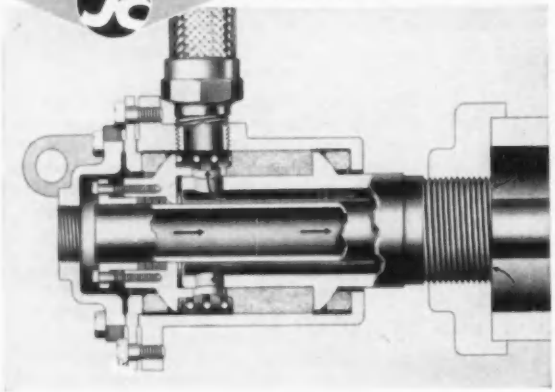

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Autotronics Expands Plant, Personnel

Autotronics, Inc., Florissant, Mo., manufacturer of miniature and subminiature electromagnetic clutches and brakes, has completed an expansion program that has more than doubled its production facilities. Long-range expansion plans include construction of a large new office and engineering building, scheduled for occupancy in about two years.

Plant size has almost tripled, and new production machinery units have been installed and are now in operation.

New Engineering Group to Build Stellarator

An unusual organization, C Stellarator Associates, has been established by Allis-Chalmers and RCA to design and build a facility at Princeton U. for advanced research into controlled thermonuclear reactions. The Model C Stellarator, located at the university's James Forrestal Research Center, Princeton, N. J., is scheduled for completion in 1960. An engineering and administrative staff of about fifty, from both corporations, will design the Model C Stellarator and coordinate fabrication of its components.

Airtron, Inc. Adds Two New Manufacturing Plants

About 40,000 sq ft of floor space in two separate buildings have been added to the existing five plants of Airtron, Inc., Linden, N. J., manufacturer of microwave components for radar systems and accessories for aircraft and jet engines. The company's seven plants, one in Cambridge, Mass., the others in Linden, N. J., are now in full operation, employing about 1,000 people.

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CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.
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New timing motor rated 60 in-oz torque...

New permanent magnet motor series by Cramer includes "double-strength" and military versions

High torque output, truly synchronous operation, instant starting and stopping, are inherent features of permanent magnet timing motor design. These advantages have been optimized in the new Cramer Type 117, resulting in a motor line with maximum application flexibility.

Five basic versions

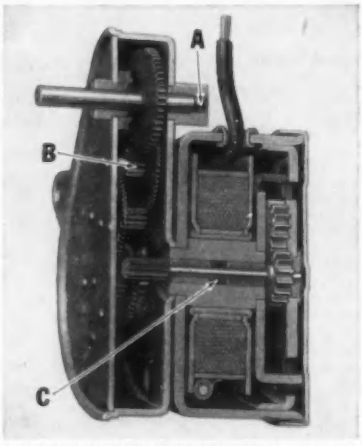
Series 117 comes in five basic forms (1) Form P, the standard, highest quality 30 in-oz (at 1 rpm) instrument motor, (2) a militarized version of Form P, (3) Form H, a "double strength" version, (4) Form M, for economy in high volume use, and (5) Form N, a compact, cylindrical gear-train model.

All have these features: instant starting, absolutely synchronous operation, and permanent magnet braking. Coil voltages up to 250V ac, 50 and 60 cycles. Input less than 2.5 watts at rated voltage. Temperature rise only 35°C. Ambient temperature range −20°F to +130°F. Gears all hobbed, with drawn pinion rod. Underwriters' Laboratories approved.

NEW CRAMER TYPE 117 MOTOR. The Type 117 motor, in its several forms, replaces Cramer Types 111, 112, 113, 114 with greatly improved performance.

Standard for quality

The standard version of the Type 117 motor, Form P, is rated 30 in-oz torque at 1 rpm. It's ideal for instruments and industrial control devices requiring field-proved dependability, timing accuracy and longest service life. Oilite rotor bearings, bronze upper and lower output bearings, and a ball thrust bearing backing up the output shaft give exceptional life and performance. A soldered gear cup cover keeps dirt out and lubricant in. Over 100 available speeds from 1 rev. per second to ½ rev. per day.



IMPROVED BEARINGS help double life expectancy of Type 117 motors. Forms P, H feature ball thrust (A) in lower output bearing. All forms boast hobbed gears throughout (B), and Oilite rotor bearings with permanent supply reservoir (C).

Double-strength version, too

Type 117 is offered also in a "double-strength" model, (Form H) rated 60 in-oz at 1 rpm. Applications are in heavy chart recording devices, high speed counters and the like, requiring high torque at fast speeds—as, for example, in the Cramer Type 640E running time meter which reads in 1/10 seconds. Readily available in speeds 60 rpm to 2 rpm. Like the Form P, external finishes are tin and cadmium plate, protected by clear iridite.

A form for economy

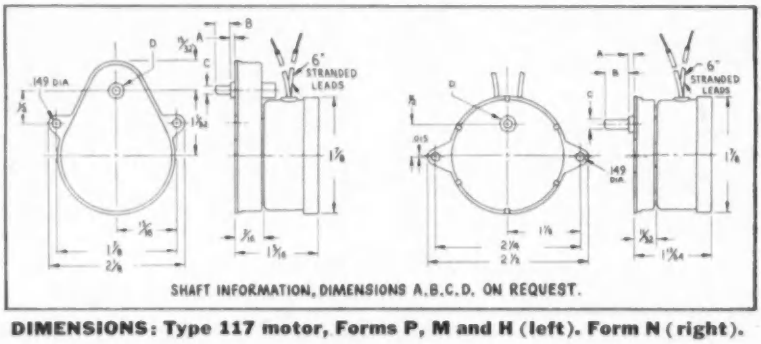
Economy for volume applications is dominant in the Type 117, Form M motor. It has the same torque and wide variety of speeds as the standard industrial version, Form P, above. A few differences: Ball thrust bearing is not used. Gear cover is crimped (instead of soldered) and external finishes are natural brass and black oxide. Advertising displays, appliance timers, vending machines are typical applications.

This one saves space and money

A space-saving cylindrical gear train —same diameter as the basic motor— is the big feature of Form N, Type 117. Basic motor is the same as the economical Form M above. Ideal for limited space applications, Form N is offered in speeds from 60 rpm to 1/12 rpm.

MilSpec model

The militarized version, identified as "Form P, Military," is practically identical with the standard version except for the coil which (here) is vacuum impregnated and supplied with high-temperature rated insulation on the leads. Ambient operating temperature range −55°C to +85°C.



DIMENSIONS: Type 117 motor, Forms P, M and H (left). Form N (right).

Write for complete data on the new Cramer Type 117 motors today. Or better yet, ask your nearest Cramer representative to tell you about them. Cramer Controls Corporation, Box 7, Centerbrook, Connecticut. 7.30

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To get more data about new Components, Materials and Parts fully described on pages 99-134, just circle the appropriate key number.

To get more information about advertised products, circle the page number of the advertisement in which you are interested. If more than one advertisement is located on a single page, letters preceding number identify each advertisement. Key: T—Top; B—Bottom; R—Right; L—Left; TL—Top left; BL—Bottom left; TR—Top right; BR—Bottom right.

For specialized data . . . prices, sizes available, nearest source of supply, etc. . . . do not circle key number but indicate your needs in the space allotted at the bottom of the card. Use this space, too, if information about a specific product among several mentioned in an advertisement is desired.

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Description of these new engineering materials appear on pages 99-134. Circle key number for more data

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2—Miniature Lubrication System
3—Tandem-mounted Control
4—Panel-mounted Remote Control
5—Heat Control
6—Self-regulating Relief Valve
7—Colored Teflon Rod Stock
8—Meter Retains Reading
9—Subminiature Servo Motor
10—Indicating Controller
11—Preset Counter
12—Counter-timer
13—Portable Heavy-duty Pump
14—Cylinder-operated Valves
15—Time and Frequency Counter
16—Fast-response Thermocouple
17—Heavy-duty Oil Seals
18—Valves With Static Seals
19—Shorter Motor
20—Transducer
21—Drive-pin Rivets
22—Teflon O and V-rings
23—Spacesaving Panel Meter
24—Magnetic-tape Handler
25—Integral and All-motor Gearmotors
26—Surface Alloy for Molybdenum
27—Timer Withstands Shock
28—Elapsed-time Indicators
29—High-temperature Relay
30—Electric Vibrators
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32—Self-lubricating Pulley
33—Elliptical Developing Tank
34—Eight Scales
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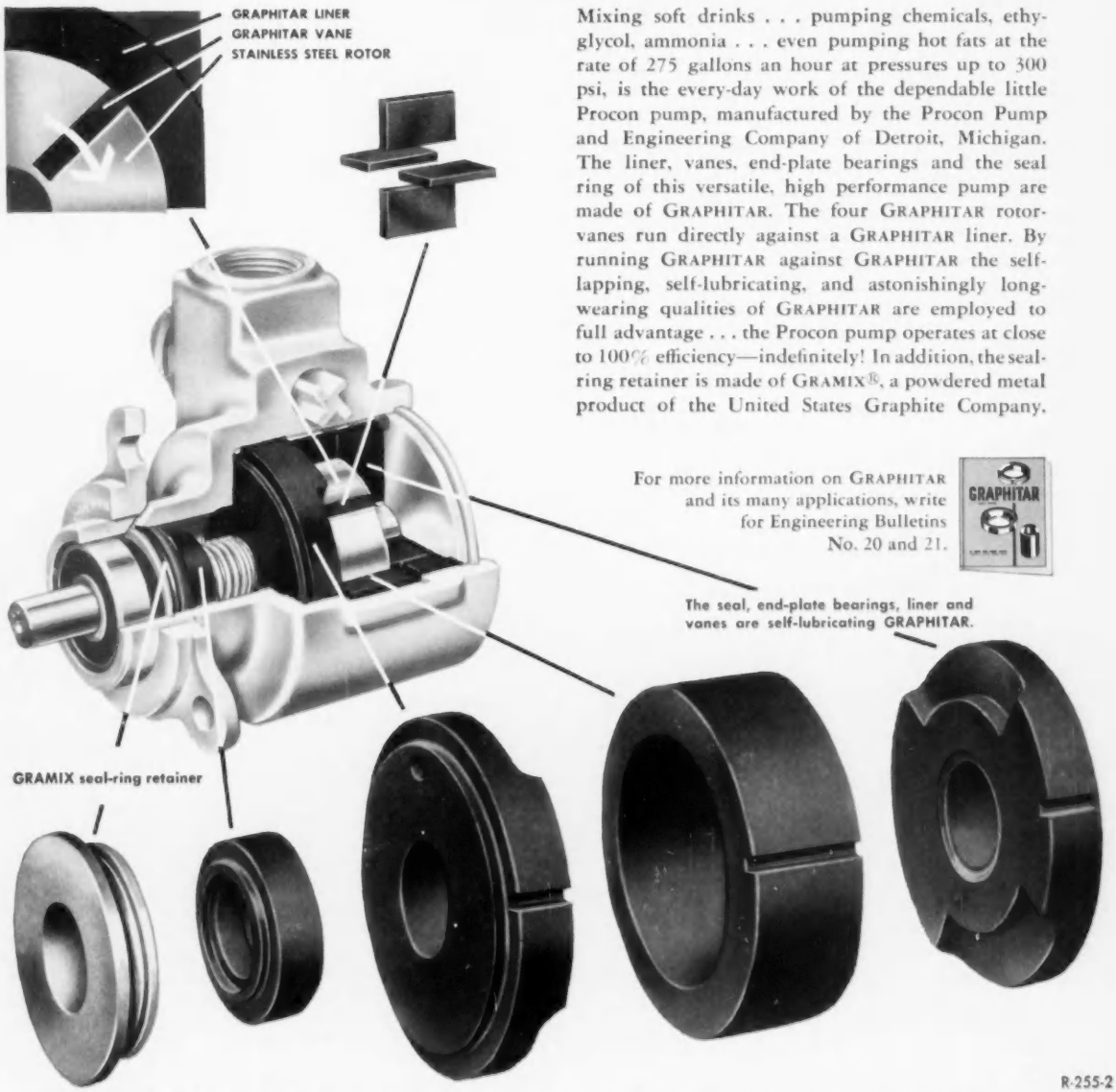
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